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MASTER THESIS

Environmental Impact Assessment Report of the mountain race "Gran Trail de Peñalara" in the Guadarrama National Park

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Declaration

I hereby declare that I am the sole author of the thesis entitled: “Environmental Impact Assessment Report of the mountain race Gran Trail de Peñalara in the Guadarrama National Park”. I duly marked out all quotations. The used literature and sources are stated in the attached list of references.

In Prague on 18.04.2018 _____

Alba Herreros Garrido

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Abstract

It has been recorded a great increase of mountain races in the Spanish Protected Areas during the last decades, which can cause a rise of the environmental negative effects on these natural areas. One of the most famous mountain races is the Gran Trail de Peñalara, a race celebrated in the Sierra de Guadarrama National Park, a Protected Area located in the Central System of the Iberian Peninsula. During the next months, the new Use and Management Master Plan (PRUG), which lays down the regulations to be follow in the National Park, will be implemented. For that reason, Royal Spanish Alpinism Society (Real Sociedad Española de Alpinismo, RSEA), organizer of the Gran Trail de Peñalara race, has requested an Environmental Impact Assessment report, to assess all the potential impacts generated by this mountain race. To do this, firstly it was study the natural elements of the National Park that make up the environmental inventory with descriptions of the key environmental processes and interactions. Taking this into account, and after the study on digital cartography and fieldwork, it was analysed the likelihood significant impacts, and classified in Ecologically Sensitive Areas, which are the ones having the ecological or physical elements of greatest interest and that can potentially suffer more affection due to the celebration of the race. The most significant impacts found were the erosion of soil because of the amount of diffuse trail networks, the damage to vegetation by trampling and damage to water courses wildlife. As a solution of all these negative effects generated by the race, it will be necessary to carry out a series of technical corrective measures, such as signposting of trails and water courses, the location of aid station in urban areas or forest paths, avoid producing loud noises, and monitoring, and some preventive measures as environmental education activities. As long as these preventive and corrective measures are implemented, the celebration of the race will be compatible with the natural values of the Sierra de Guadarrama National Park.

Keywords: Trail running, impacts, environmental assessment, trampling, ecologically sensitive areas, Sierra de Guadarrama, corrective measures.

Abstrakt

V posledních desetiletí značně narostl počet horských závodů, které vedou i skrze chráněné lokality, a které mohou navyšovat negativní environmentální tlak v těchto území. Jedním z nejznámějších z těchto horských závodů je Gran Trail de Peñalara, závod v národním parku Sierra de Guadarrama, čož je chráněná oblast nacházející se v centrálním systému Pyrenejského poloostrova.
V nadcházejících několika měsících bude implementována nový plán využití a řízení (PRUG), který stanoví pravidla, jež budou muset být v národním parku dodržovaná. Z tohoto důvodu společnost Royal Sociedad Española de Alpinismo (RSEA), organizátor soutěže Gran Trail de Peñalara, požádala o realizaci zprávy o posouzení dopadů na životní prostředí tak, aby byly zhodnoceny všechny možné negativní environmentální dopady tohoto horského závodu. Za tímto účelem byly studovány jednotlivé živé i neživé složky životního prostředí. S ohledem na tuto skutečnost byla analyzována pravděpodobnost významných dopadů a klasifikace ekologické zranitelnosti u environmentální citlivých oblastí, jež by mohly být závodem ohroženy.
Nejvýznamnější rizika byla identifikována v podobě eroze půdy, poškození vegetace sešlapem, a poškození či likvidace volně žijících živočichů. Jako řešení všech těchto negativních efektů potenciálně způsobených závodem bude nutné provést řadu technických nápravných opatření, jako je značení tras a vodních toků, umístění stanice první pomoci ve městských oblastech nebo v rámci infrastruktury lesních cest, předcházení hlukovému zatížení, monitoring a environmentální výchova a osvěta. V případě realizace všech těchto preventivních a minimalizačních opatření je provádění závodu slučitelné s ochranou přírodních hodnot v Národním parku Sierra de Guadarrama.

Klíčová slova: Běžecká stezka, vliv, posuzování vlivů na ŽP, sešlap, ekologicky citlivé oblasti, Sierra de Guadarrama, zmírňující opatření

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1. Introduction

Background and general data

In the last decade, it has been recorded a great increase of mountain sports and outdoor activities in Spain. The most practiced sports modalities are not soccer, basketball or tennis, but cycling (38.7%), swimming (38.5%), hiking and mountaineering (31.9%) and trail running (30.4%) (EUROPARC-España, 2016). Between 2010 and 2015 hiking and mountaineering has increased by 21.4%, becoming to be the third most practiced modality in 2015, and trail running has increase 6.6% (Segui Urbaneja & Inés Farias, 2018). Trail running is the modality that brings more runners, more than 124,000, with an average of 381.

This phenomenon is well seen by the tourism and rural development administration and by municipalities and regions, since trails running have served to recover previously forgotten territories. Trails running make rural tourism more dynamic as, it not only mobilizes organizers and runners, but also attracts a significant number of spectators. Besides, as Snetsinger and White said in 2009, outdoor recreational experiences contribute to individual health of body and spirit, foster appreciation of and support for environmental protection by the public.

In spite of it, the popularization of the trail running has increased in a way that can endanger the conservation of natural areas where those are celebrated. Having into account the most current data, around 1,900 mountain races are celebrated in Spain, and most of them run through protected areas. Most of the races on Protected Areas, 47% of the total, are concentrated in the spring and early summer, months from March to June (EUROPARC-España, 2016).

It is estimated that about 700,000 people run annually in these mountain race modalities inside singular natural areas. Only 23% of the mountain races are controlled and organized by The Spanish Federation of Mountain Sports and Climbing (FEDME in Spanish) by itself or regional federations belonging to it, and the other 77% are organized by city councils (24%) or other local and regional administrations (7%), associations (23%), companies (16%), and others (NGOs, individuals, etc. 7%).

In the region of Madrid, it was celebrated 97 races during 2015, all of them inside Protected Areas. There is data from 80 of them, counting 24,060 runners and an average of 300.75 per race (EUROPARC-España, 2016).

Trail running on Guadarrama National Park

Guadarrama National Park is one of the Protected Areas with the largest number of runners, 10,050 (EUROPARC-España, 2016). Only in 2014, one year after the official Park statement, were ran more than 40 races, with an average of 500 runners in each race.

The first mountain race done in Guadarrama National Park was celebrated in 1916 and it was organized by the already defunct "Sociedad de Amigos del Campo". Its route connected Cercedilla with Siete Picos summit, running through what today is the Guadarrama National Park.

Currently there are about 30 mountain races within the National Park and its area of influence, with an approximate total number of 13,500 runners. From 2013, there has been an increase in the number of new competitions emerged, due to different reasons, among which can be highlight: the

mountain race "boom", the touristic attraction of the title "National Park", and because of new race promoters are trying to "establish" themselves in the territory before the future National Park Usage and Management Master Plan (Plan Rector de Uso y Gestión) limits activities within the Park (Oñorbe, 2014).

Guadarrama National Park is, by far, the one hosting the largest number of mountain races within the Spanish National Parks network, and it is the most visited one with 3.5 million annual visits.

One of the most popular and longest mountain races held in this National Park is the Gran Trail de Peñalara. This race was created in 2010 by the Royal Spanish Alpinism Society Peñalara (Real Sociedad Española de Alpinismo Peñalara), due to the great tendency of the time of the long races called "Trail or Ultra Trail", and with the intention of spreading the values of the Sierra de Guadarrama towards a more international scope.

The GTP links different mountain towns through paths used since past times by farmers, hunters, travelers and in more modern times by hikers and mountaineers, having as main axis the “Sendero de Gran Recorrido GR10”. Its route has a distance of 116 km, with a cut-off time of 28 hours. It is a circular race in semi-self-sufficiency where participants must carry a minimum material that guarantees their safety throughout the entire journey. It is a high mountain race, with altitudes above two thousand meters, reaching the highest point at 5,100 meters, and whose route covers territories of the Province of Segovia (Regional Government of Castilla and León) and Province of Madrid (Community of Madrid).

The GTP is included within the scoring races to be able to participate in the Ultra Trail of Mont Blanc (France), an accredited world class event and considered informally the World Championship of the Ultra Mountain Trail, and, in October 2013 it has also been included in the list of qualifying races to be able to participate in the prestigious Western States Endurance 100 celebrated in California (USA) and pioneer of the Ultra Trail. These facts give the Gran Trail de Peñalara more standing and importance.

Regulation of Trail running in Sierra de Guadarrama National Park

These type of mountain races like the GTP are currently regulated by the Natural Resources Management Plan (PORN) of Sierra de Guadarrama (Madrid) in the territorial area of the Community of Madrid and the "Sierra de Guadarrama" Natural Area (Segovia and Ávila). The Decree 96/2009, of November 18, of the Governing Council, which approves the Natural Resources Management Plan (PORN) of Sierra de Guadarrama in the territorial area of the Community of Madrid, specifies three quite superficial requirement and of ambiguous interpretation to be fulfilled in order to be authorised by the appropriate environmental body. In response to this problem, on February 26, 2015, the Sierra de Guadarrama National Park´ Organism published a document with the guidelines that would regulate and rule the authorizations of sport activities in the Park until the final approval of the PRUG (Use and Management Master Plan). With this document coming into force, more important aspects in regard to mountain race´ environmental problems become regulated.

However, it is during these last months when the Use and Management Master Plan (PRUG) has been drawn up, which will complement these management tools. The Use and Management Master Plan

(PRUG) is the final document that will regulate all the projects and activities, and it will establish objectives for the management of the National Park for the coming years, establishing a zoning of uses. It was published on December 27, 2017, to be subjected to public information in order to make allegations, before finally being approved jointly by the Community of Madrid and the Junta of Castilla and León.

The article 48 refers to exceptional sports events. This type of sport events are those with no significant environmental impact that begun to be celebrated before the effective date of the declaration of the Sierra de Guadarrama National Park (June 26, 2013). They are referred to as "Sports events and competitions with low environmental impact that can be authorized on an exceptional basis". The GTP, created in 2010, would be within this type of sport events. In this same article (48), it is also pointed out a series of requirements that these type of events must follow.

Problematic of Mountain Races

In regard to the problematic of mountain race, it is needed to say these type of races in nature are recreational activities that can cause an impact in the environment. An impact is an undesirable change in environmental conditions, and it is important to know the type, amount, rate, and duration of undesirable change occurring to the resource base as a result of recreational use. Undesirable change to the resources is defined as degradation of the soil, vegetation, wildlife, water and associated resources of a wildland area (Hammitt, Cole, & Monz, 2015).

Common trail impacts include soil erosion, trail wetness or muddiness, creation of parallel secondary treads and informal side-trails, vegetation cover loss or composition change, soil compaction, and trail widening (Farrell & Marion, 2001).

Trampling and removal of vegetation are generally one of the first reasons of impact. Trampling often increases the bulk density of the soil, which, in turn, decreases soil porosity and changes moisture content, aeration, and the availability of soil nutrients in ways that contribute to further losses of existing vegetation along trails (Wilson & Seney, 1994). In addition, accelerated soil erosion becomes the primary problem once the vegetation is lost (Cole, 1987). But there exist so many other problems that mountain races without proper environmental management can cause, such as damage to protected species of fauna and flora, negative effects on animal behaviour or alteration of their habitats.

2. Aims of the project

This project was carried out with the aim of creating an environmental report on the possible impacts generated by the mountain race “Gran Trail de Peñalara”, celebrated in Guadarrama National Park, and with the intention to find a series of applicable measures in order to avoid or minimize those impacts. This environmental report was requested in July 2017 by the Real Sociedad Española de Alpinismo Peñalara RSEA (Royal Spanish Alpinism Society Peñalara) to the work team of “investigation and public use” of the Autonomous University of Madrid (UAM), due to the increasing problem that is being generated by the first draft of the Guadarrama National Park Usage and Management Master Plan (Plan Rector de Uso y Gestión, PRUG) in relation to mountain races. The

RSEA wants to show to the responsible authority for this Master Plan that the GTP race does not harm or damage the environmental values of the park.

This organization (RSEA) will be the responsible of taking the report to a public participation process, both with individuals and social agents and interested organizations. After this, a final report will be issued, and it will be the competent administration the one taking the final decision about the project.

This environmental report is the so-called Environmental Impact Assessment Report, which is one of the essential parts of the Environmental Impact Assessment. The specific objectives of the report include the key points that conform an Environmental Impact Assessment Report, which are the following:

a) Carrying out an environmental inventory about the area where the GTP takes place.
b) A subsequent evaluation of the impacts that it generates on the environment, that is, the effects caused on fauna, flora and soil.
c) An assessment of these impacts and proposal of corrective measures.

The celebration of mountain races in the Guadarrama National Park, protected area shared by the Community of Madrid and the province of Segovia (Community of Castilla and León), brings with it a series of consequences. In recent years, several corrective measures have been implemented in order to help with the improvement of the impact situation these mountain races cause on the natural environment. Even so, the high amount of runners participating in these type of races, and specifically in the GTP that will be analyse in this project, end up causing impacts on the environment, due to the massive trampling of runners over plant species, degraded edaphic materials or even wildlife species, and of course, weak environmental management plans. Therefore, here it will be analysed which are the possible areas with the greatest alteration, called “Ecologically Sensitive Areas (ESA)”, and the possible measures to be taken in attempting to reduce the impacts.

3. Materials and methods

3.1. Study area

The long distance race Gran Trail de Peñalara, which will be referred as GTP throughout the report, is a 116-kilometer mountain race held in the Sierra de Guadarrama National Park. Guadarrama National Park is a Protected Area located in the Central System oriental side, one of the main systems of mountain ranges in the Iberian Peninsula. It has a surface of 33,960 hectares along the heights of the Sierra de Guadarrama, of which nearly 64% (21,714 hectares) belongs to the Madrid Autonomous Community, and the remaining almost 36% (12,246 hectares) belongs to Segovia, in the Community of Castilla and León. It was declared National Park in 2013 by the Law 7/2013, June 25th, Sierra de Guadarrama National Park (BOE 26/6/2013).

The GTP has a circular route that begins and ends in Navacerrada village (Madrid), and it crosses very diverse lands and environments, from the low areas foothills of this Central System to some of the highest and most representative peaks of it, such as La Maliciosa or Peñalara summits.

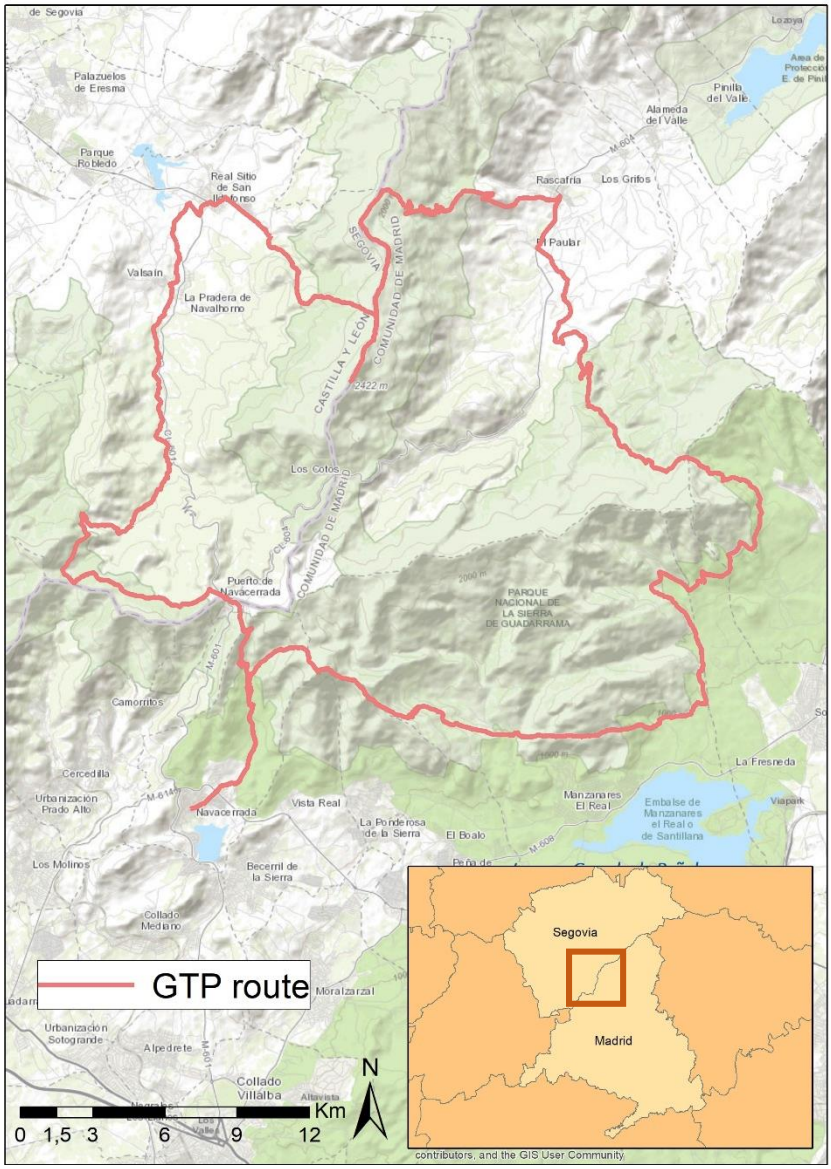

Figure 1. Geographic context of the GTP

3.2. Gran Trail de Peñalara and route description

As it was already mentioned, the race starts from the Navacerrada urban core in the direction to La Barranca, where it enters the Woodlands of Public Benefit "Pinar de La Barranca", a pine forest mass. From there, following the path PR 26, although taking a shortcut and always moving forward along a trail, it reaches the Collado del Piornal (2074 m), between Alto de las Guarramillas (Bola del Mundo) and La Maliciosa summits. It goes towards the second one (La Maliciosa) taking the PR 16, and once reached it, at 2227 m.a.s.l., it continues for this path on way to La Pedriza, crossing the Collado de las Vacas and going across the crests of Sierra de los Porrones as it returns to descend in altitude. In the kilometric point (k.p.) 12.1 it leaves the PR 16 to go back again into the pine forests mass of the Sierra de los Porrones northern slopes. This is how it reaches Canto Cochino, and from there, along the path of Cordel de La Pedriza, it makes its way through the Collado de La Pedriza, it crosses this from west to east towards El Berrueco, and it takes the GR 10 path on the k.p 21.5.

In El Berrueco, the route leaves the abrupt relief of the granites of La Pedriza and comes down to the minimum altitude of the GTP, around 950 m.a.s.l., and heads towards the Hueco de San Blas, combining stretches of trail and forest path between dehesas and crops. It turns around this topographic element along the forest path that surrounds it, heading towards the Puerto de la Morcuera (1777 m.a.s.l.) along the pine hillsides that surround La Najarra peak. When it arrives at the Puerto de La Morcuera mountain pass, it enters the repopulation pine mass growing north, in the direction of Rascafría, on the path GR 10.1. Before reaching Rascafría through the M-604 road, the route crosses Quercus pyrenaica forest and patches of meadows and crops. This part of the route that links the Puerto de la Morcuera with Rascafría runs entirely along forest path.

From Rascafría village, the route is directed towards the route PR 10 and it makes the runners to go up to Puerto del Reventón (2039 m.a.s.l.). From El Reventón, along the PR 32 path that follows the range that goes to the Peñalara peak (2428 m.a.s.l., maximum height of the GTP), the route runs along the Alto de los Poyales, Cerro Claveles and Risco de los Pájaros summits. At the beginning of this mountain range, areas of thalweg or greater saturation of the soil appear again. The final trail to Peñalara from Puerto de los Neveros (2096 m.a.s.l.) is roundtrip, that means the passage of runners is doubled at this part of the route. From the latter point, Puerto de los Neveros, the race route descends to the village of La Granja de San Ildefonso through the western hillside of Peñalara, going across the pine forest mass, mixed with oak in the lower levels.

Figure 2. Risco de los Pajaros

The route links La Granja de San Ildefonso with Valsaín following the course of the Eresma River, through an area of somewhat indefinite and confusing trails, and very close to the riverbed and the riverside area. Going inside the pine forests of Montes de Valsaín, the trail joins the GR 10.1 which ascends to Fuente de la Reina. From there, and taking the extraction road that goes parallel to the forest path going south, it reaches the Puerto De la Fuenfría (1792 m.a.s.l.). Finally, following the path Senda de los Cospes first, and the path Camino Schmid after it, the route reaches the mountain pass Puerto de Navacerrada.

The last section of the route descends from Puerto de Navacerrada taking the path PR 17 to Risco de Emburriaderos on its eastern slope. In this descent to the pine forest and once inside it, the trail becomes somewhat diffuse and narrow during a considerable stretch (k.p. 105.6 to k.p. 107.8) in which there could be possible shortcuts. Once reached La Barranca, the route takes again the forest path took at the beginning of the race, but now in the opposite direction, to Navacerrada village.

3.3. Environmental Impact Assessment Report

As it was already specified, the aim of this project is to conduct an Environmental Impact Assessment Report. This Environmental Impact Assessment Report is part of an Environmental Impact Assessment that is being carried out about the race due the reasons explained in the previous section "Aims of the project". An Environmental Impact Assessment (EIA) is defined by the UNEP (United Nations Environment Programme) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. The Environmental Impact Assessment Report (EIAR) is the principal document that the EIA process is based on. EIAR is a document that contains the necessary information to evaluate the possible significant effects the project has on the environment and it allows taking the appropriate decisions to prevent, minimize or correct these effects.

Thus, the EIA is a process that attend to two complementary aspects. On the one hand, it establishes the legal-administrative procedure for the approval, modification or refusal of a project or activity by the appropriate administration. On the other hand, it tries to elaborate a systematic analysis and assessment of the potential effects of the proposed project on the receiving environment, this is the technical document itself, the objective of this report.

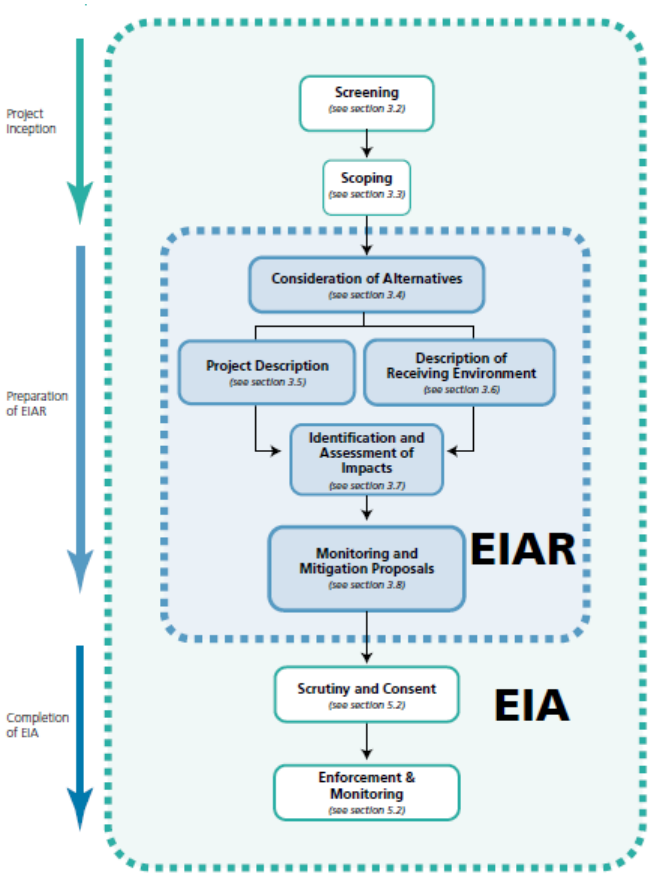

Figure 3. The Position of an EIAR within the EIA Process.

Through the evaluation of impacts to the environment caused by the race, a series of corrective measures and modifications may be taken that help in the celebration of the activity in a more ecological way, avoiding those possible negative effects that may occur to the environment.

After the EIAR is done, the report is taken to a process of public participation, both of individuals and social agents and interested organizations. After it, the final report is issued and the final step is to wait for the decision that the competent authority will take about the project.

The evaluation of the environmental impact must include, at least, the estimation of the effects on human life, fauna, flora, vegetation, soil, water, climate, landscape, structure and function of the ecosystems present in the area foreseeably affected.

The EIAR of a project or activity, as it is established in the Annex VI of the Spanish Law 21/2013 on Environmental Impact Assessment, consists of the following sections:

- A description of the project, in this case the mountain race GTP, already made in the previous point of this Methodology.
- An environmental inventory and a description of key ecological or environmental processes and interactions.
- A description of the likely significant effects that the project has on the environment.

- An assessment of the found potential impacts and a description of the measures envisaged in order to avoid, prevent or reduce and, if possible, offset this significant adverse effects on the environment.

❖ Description of Receiving Environment - Environmental Inventory

The first step in the execution of an Environmental Impact Assessment Report is the Environmental Inventory. The environmental inventory reflects the physical, biological and socioeconomic conditions of the study area, that is, the environment where the race takes place. This part of the EIAR allows to know the state and environmental conditions of the Sierra de Guadarrama before the celebration of the race (baseline scenario), as well as the current occupation of the soil in the area, the existing activities and the use of natural resources.

To carry out this environmental inventory, an identification, inventory and qualification of all environmental aspects that may be damaged by the race must be done. It must also be accompanied by a descriptive cartography of these environmental aspects.

The following environmental factors of the study area are analysed in detail:

- Physical Environment: Geology and geomorphology, Hydrology, Edaphology
- Biological Environment: Fauna and Flora
- Legal and Conservation context

For this study and analysis of the environmental factors named above, different types and sources of information were taken into account. Cartography from the web pages of the Ministry of Agriculture and Fisheries, Food and Environment, the Community of Madrid and the community of Castilla and León was selected, and also reports related to this cartography, as well as other documents already made on other mountain races or about environmental information of the Sierra de Guadarrama. With this ensemble of documents and always following the route of the race and selecting the precise information on each area, the study of these environmental factors has been completed. The methodology followed in each of them is detailed below.

The geology and geomorphology, as well as hydrology, were analysed by observing and studying the digital thematic cartography (geological map and hydrological map) and their corresponding memories, taking into account, as specified in the previous paragraph, the points where the race takes place, and merging this information with other documents already made on the geology and hydrology of the Sierra de Guadarrama.

A similar method was followed for the edaphological analysis. The existing cartography on types of soil in the community of Madrid was observed and the information was detailed according to the legend and memory found in the FAO-UNESCO document (Food and Agriculture Organization of the United Nations) and the information found in the blog "The soils and the life" by José Ibañez, professor of the University of Extremadura in the Department of Biology and Production of Vegetables.

Regarding to the flora, several documents with relevant information on the flora and vegetation of Guadarrama mountain range were analysed, as well as digital cartography on types of habitats and vegetation, and merging all this information in relation to the areas through which the race goes. In addition, catalogues of endangered species in the community of Madrid and the Peñalara Natural Park were taken into account. All this information was completed after field work on the most important areas.

The fauna was also analysed following the cartography and the different documents related to the fauna of the Sierra de Guadarrama, taking into account the digital cartography and the types of habitats in order to be able to detail which species could appear throughout the race, and also taking into account their biological and reproductive cycles. Two of the most important sources of information are the Regional Catalogue of Endangered Species (CREAM) and the Iberian vertebrates' virtual encyclopaedia.

Lastly, the information on the legal and conservation context in the environment of the race was analysed based on the creation of maps of the protection figures existing in the area, by creating maps with ArcGIS software (Appendix 1), together with information on the current legislation of each of these protection figures that may be applicable to mountain races.

After having all this information, it comes the next step, the identification of the possible impacts that the race causes on the natural environment.

- **Identification of possible impacts**

It will include the identification of the foreseeable significant effects of the race on the environmental factors previously indicated.

Necessarily, the identification of environmental impacts will come of the study of interactions between the actions derived from the race and the specific characteristics of the environmental factors affected in each specific case.

For the identification of possible impacts, a detailed and exhaustive fieldwork and cartographic review were performed, looking for those points or areas of the race in which the impact on the natural environment was more significant.

In the first place, a research work was carried out through a review of the existing cartography on the area and taking into account the previously detailed environmental inventory. In this cartographic review, the possible areas where the impact on the environment was more significant were identified. After this, several field research were made in these previously identified zones. During this fieldwork, the factors that could be affected by the activity derived from the race were settled on. Therefore, it was observed the type of path through which the race passes, the growing vegetation in the vicinity of trail and its degree of protection, the possible fauna that could inhabit these areas, taking into account their biological and reproductive cycles, and the number and state of fords crossed by the race along its route. After analysing the possible impacts of the race, maps were created from the ArcGIS software (Appendix 2). These maps display those areas with the most significant impacts or more prone to suffer damage, called Ecologically Sensitive Areas (ESA), and from these, each of the impacts or negative effects found were detailed. Different types of impacts

were distinguished, either for reasons of erosion to the soil, negative effects to flora and fauna, negative effects to aquatic systems or waste generation.

❖ **Assessment of the found environmental impacts and description of corrective measures**

The last step in this EIAR is the assessment of the likely significant impacts found after the study of the area, and the subsequent proposal of measures that can avoid or correct them. To do this, firstly it was drawn up a table with all the impacts classified by the type of environment in which they were found (soil, flora, fauna, water, and other types of impacts). In this table it was evaluated the frequency in which the impact could occur, the magnitude of the impact in case it occurred, and finally the capacity of the medium to resist this impact. It was analysed, following these three characteristics, which could be the most important likely impacts to be taken into account. The analysis was carried out with the opinion of three researcher of the work team of the Autonomous University of Madrid (UAM).

Lastly, preventive and corrective measures were proposed in order to avoid these possible negative effects on the environment or correct them. For the proposal of these measures, previous environmental impact assessment reports of other minor races carried out in the National Park were taken into account, together with other articles on good environmental practices in mountain races.

4. Results

4.1. Environmental inventory

4.1.1. Geology and Geomorphology

The Sierra de Guadarrama, through which the entire race transits, is framed within the Central Mountain Range, Sistema Central, in its mid-eastern zone, with an orientation from southwest (bordering with Sierra de Gredos) to northeast (bordering with Sierra de Ayllón). It covers territory of the provinces of Madrid, Segovia and Ávila.

This mountainous chain was formed during the Alpine Orogeny in the form of sunken and raised Horst type blocks, about 80 million years ago. However, the materials on which it lays down are of previous origin. They were formed during the Hercynian Orogeny (380-280 million years ago), which gave rise to the granite basement that later would be raised with the Alpine Orogeny, to give place to the Sistema Central and the Sierra de Guadarrama. Thus, granites but also another type of siliceous rocks such as gneisses, with an even more ancient origin, make up the general lithology of the Sierra. It is possible to find as well lithological formations of sedimentary type, since in the Mesozoic, between the Hercynian Orogeny and the Alpine Orogeny of the late Cenozoic, the oceans' water rose and fell giving rise to processes of shaping limestone, marls and sandstone.

A posteriori, the erosive processes, quaternary glaciers and periglacials (such as those that have ended up giving shape to the Peñalara Massif) have finished shaping the geology and geomorphology

of valleys and summits. The Sierra de Guadarrama is a mountainous system with a relatively remarkable antiquity compared to other mountainous formations of the Iberian Peninsula such as Picos de Europa or the Cordilleras Béticas, being that the reason why its reliefs have been relatively softened by the erosive and moulding processes suffered over time.

Currently, the Sierra de Guadarrama relief is determined by the route of large dividing lines constituted by the mountain range forming the highest peaks, whose heights vary between 2000 and 2500 m.a.s.l. These large dividing lines draw the fluvial network and give rise to the wide valleys, slopes towards the Tajo Basin or the Duero Basin, separated one from the other by the elevation of the Central System mountain range. Specifically, it is possible to find three main dividing lines, which house the highest peaks of the Sierra de Guadarrama. All of these dividing lines leave from Alto de las Guarramillas. The first one goes to the north, crowned in the Peñalara Massif and its summits and continued by the Montes Carpetanos; the second line goes to the east and it constitutes entirely Cuerda Larga (a mountain range), one of the most famous dividing lines; and the third one that goes to the west, maybe less important, but which housed summits such as Siete Picos or Montón de Trigo, and the Fuenfría Valley. These dividing lines channel the source of the Lozoya River and its sub-basin in its highest section. To the east of the first one, however, is the sub-basin of the Eresma River the one going down the Valsaín Valley, towards the Segovian slope.

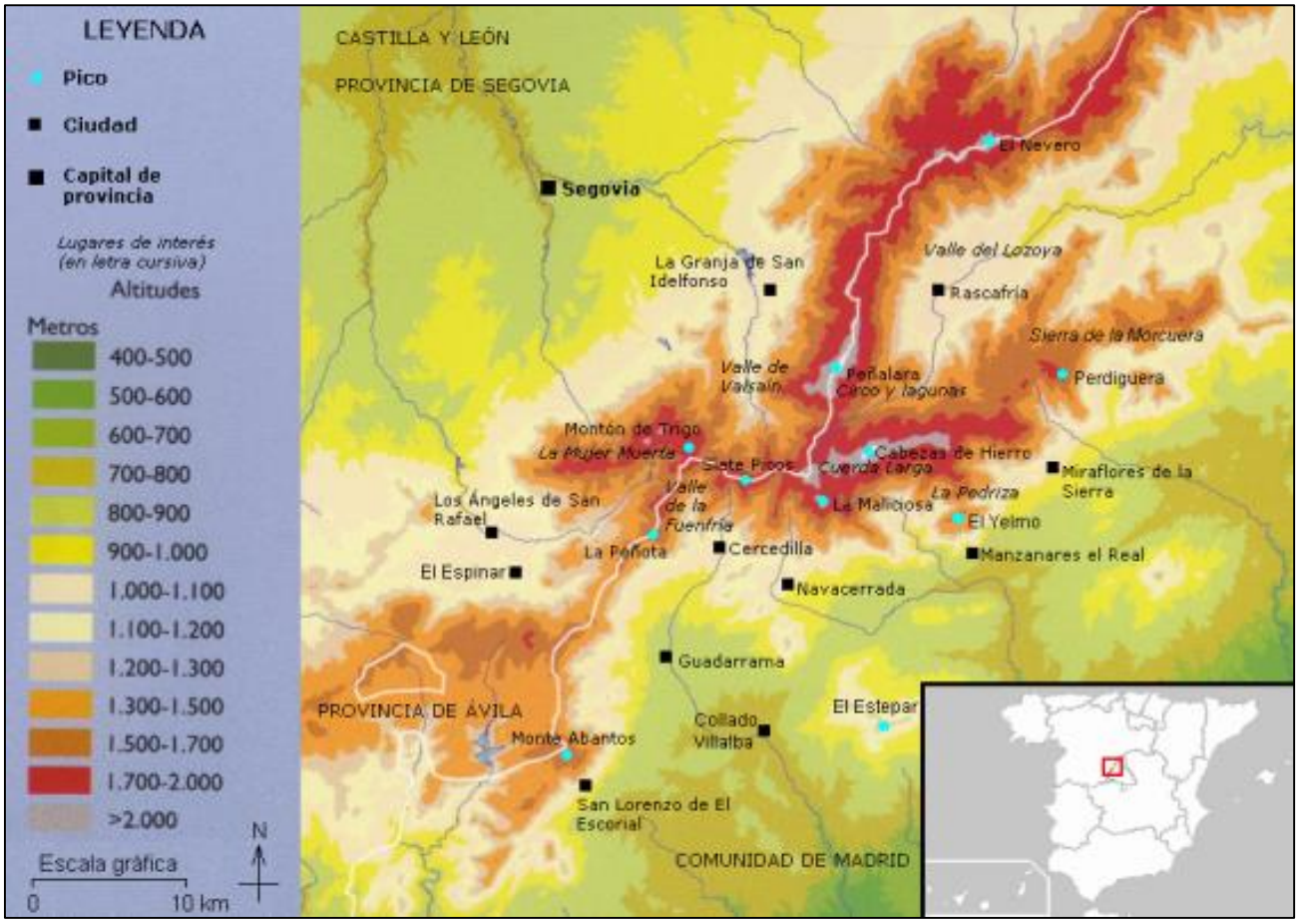

Figure 4. Physical Map of Sierra de Guadarrama

Regarding the lithology of the soils along which the race runs, it should be emphasized that the predominance of granites, as well as the metamorphic rocks gneiss type to a lesser extent. In general terms, these two different types of rock make up a good part of the Sierra de Guadarrama. In the case of granites, and as can be seen in Figure 6 with an orange, fuchsia or yellow coloration, they are the most representative along the GTP route.

- Biotitic granitoids: are those found, for example, along the section that crosses La Pedriza and El Hueco de San Blas, which present equigranular facies, or those of the Valsaín pine forests through which the route advances from La Granja de San Ildefonso towards Puerto de la Fuenfría, which present a more porphyric texture.
- Granitoids of two micas: this lithology arises in much more specific areas and is much less representative along the route. It can be found around Puerto De Navacerrada and Emburriaderos in leucogranite form.

Gneisses are the second most representative type of rock in the route of the GTP. They can be appreciated in figure 6, represented with a paler colour than the previous ones (pink, turquoise green, whitish).

- The glandular feldspathic orthogneisses, with a pale pinkish coloration in figure 6, are the most representative ones within this type of rocks in Sierra de Guadarrama and in the route of the GTP. They are the ones that form the lithic substrate from a good part of the route around the Peñalara Massif for example (mountain range from the Peñalara peak to Puerto Del Reventón, part of the descent towards La Granja de San Ildefonso ...), and also a good part of the route between Puerto de la Morcuera and Rascafría, high areas of Collado del Piornal and Maliciosa, etc.
- The paragneiss, schist, meta-sandstones and calcium-silicate rocks, represented with green turquoise in figure 6, appear as scattered outcrops between the predominant orthogneises mentioned above, as well as some quartzites outcrop in the path between Puerto de la Morcuera and Rascafría.

It is also necessary to refer to the sedimentary areas through which the route passes, which are the result of the erosive processes of the original materials cited previously. These substrates are located on the hillsides, the valleys and their bottoms, the pits and depressions, and all those locations where the resulting materials from erosion have been deposited and have given rise to different types of rocks:

- In this category, the rocky grounds of blocks and pebbles should be highlighted. These formations resulted from glacial erosion in the case of Peñalara surroundings, but also from fluvial or eolic erosion, and it occurs in colluviums form that produce alluvial fans or other forms of relief characteristic of these processes. In certain areas of the route this substrate is on surface, without any soil covering it, as it happens for example on Risco de los Pájaros´ laterals and Peñalara rocky grounds. In many other locations, this lithology has been buried under soils with a greater or lesser degree of formation, as it can happen in the paths crossing the pine forests from Puerto De la Fuenfría to Puerto de Navacerrada.

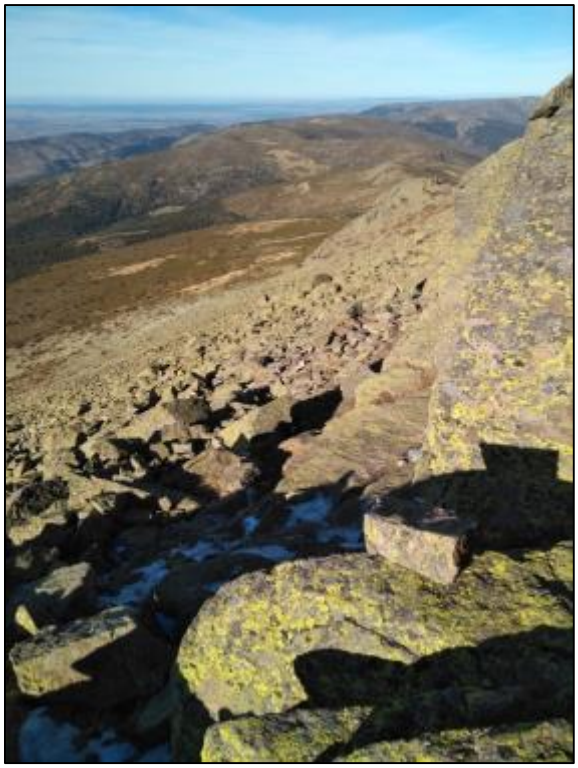

Figure 5. GTP route stretch crossing the screes of Peñalara mountain range

- Deposits of sand, silt and gravel located in areas with a fluvial action of deposition such as valley bottoms, terraces, or alluvial fans of greater or lesser antiquity, but all of them of origin Holocene-Lower Pleistocene. The most outstanding are those of the Lozoya Valley, although in this area the race runs along a forest path or paved. These materials are also represented in stretches of Cordel de la Pedriza by the action of some streams, in the transect between Valsaín and Puerto de la Fuenfría associated to Eresma River and its tributaries or in the area of Berrueco and Hueco de San Blas.

Occasionally, throughout the route, outcrops of subvolcanic rock appear, such as pegmatites, aplites and aplopegmatites that date back to the Carboniferous period.

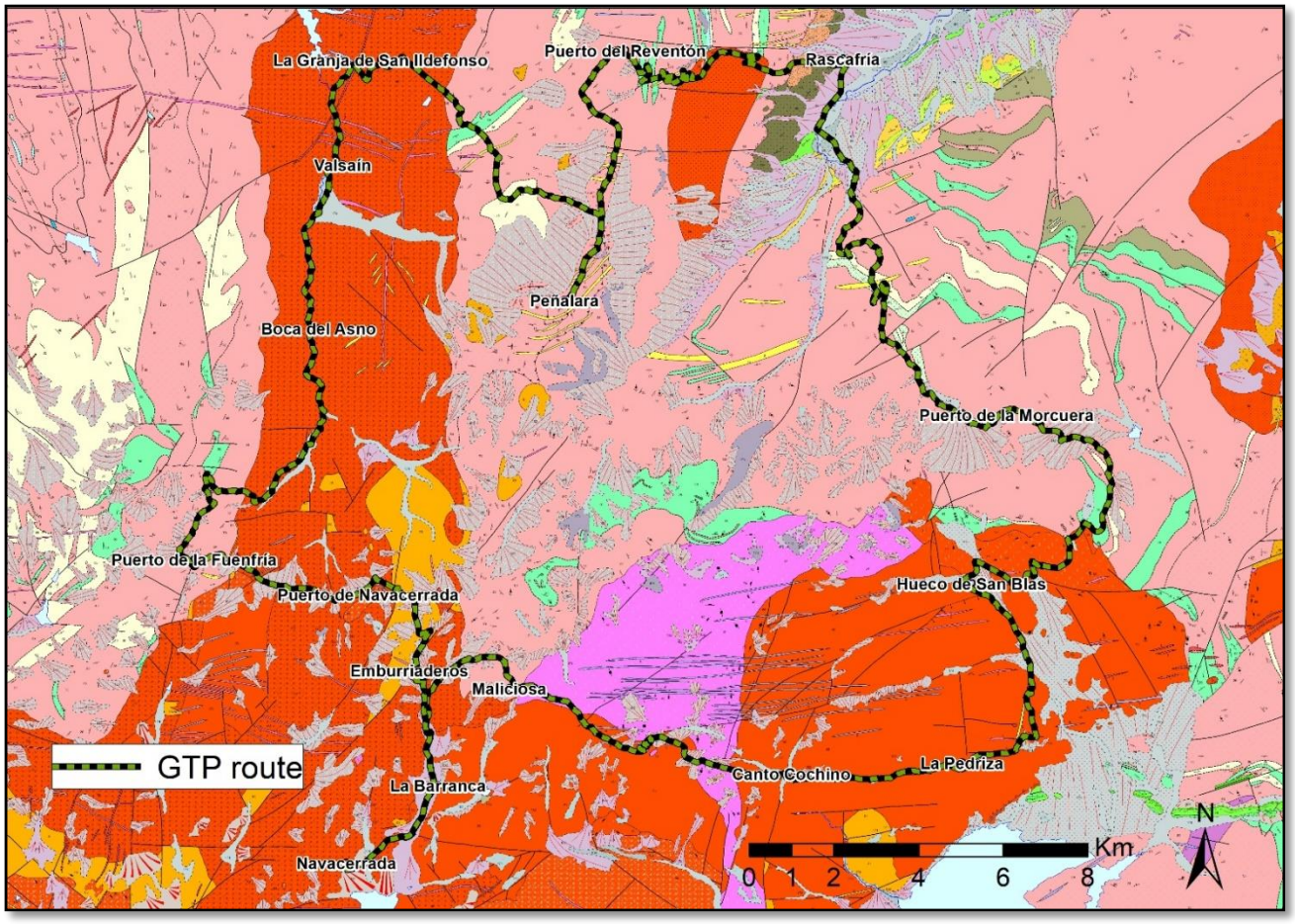

Figure 6. Geological context of GTP

4.1.2. Hydrology

- Surface-water hydrology

The race is located in the Duero River Basin and in the Tajo River Basin, with a longer section of the route in the last one mentioned. According to the available cartography, several river sub-basins can be distinguished through which the route takes place and here will be divided into two groups, depending on whether they are part of the Duero River Basin or the Tajo River Basin.

- Within the Duero River Basin, the route runs through important watersheds (sub-basins) such as Eresma, Peñalara, Puerto del Paular, Carneros and Chorro Chico.
- Regarding the Tajo River Basin, it is worth highlighting the passage of the GTP route through the Lozoya sub-basin, the Navacerrada sub-basin, the Manzanares sub-basin, the Guadarrama sub-basin, and the Mediano sub-basin.

The waters of the rivers being part of these basins are oligotrophic and of very low mineralization, a characteristic that is conditioned by the gneisses and granites predominating in this zone of the Sierra. These gneisses and granites in turn cause impermeability in the substrate, except in very localized and shallow areas of erosion and fracturing. Due to the marked Mediterranean character of this area, the climate causes these rivers and mountain streams to have small flows and highly fluctuating character, both intra and inter annual, and mainly of a pluvio-nival nature.

Coming up next, following the available cartography, is the names of the main rivers and streams that the route crosses:

In the first stretch of the race, the route runs parallel to Navacerrada river from the k.p. 2 to k.p. 5 where it crosses it, following parallel to Regajo del Cancho Negro (a small stream) until k.p. 8. In the area of Canto Cochino, the Manzanares River crosses the route in the k.p. 17. Passed the k.p. 22, the race crosses the stream Arroyo del Recuenco, and already in the Pedriza limit, k.p. 23.7, it crosses the stream Arroyo de Santillana. Arriving to Hueco de San Blas, from k.p. 26, the route runs parallel to the stream Arroyo Del Mediano, until it crosses it in the k.p. 29.4, which crosses again near k.p. 31. Between the k.p. 33 and 34, the route crosses two streams, the stream Eriales and the stream of San Blas. Further on, going up to Puerto De la Morcuera, from k.p. 37, the route crosses the stream of Vejiga and the stream of Media Luna. After passing Puerto de la Morcuera and until reaching Rascafría, the route runs parallel to the Lozoya River, crossing several streams.

On the way up to Peñalara peak, it can be highlighted the lagoons "Laguna de los Pájaros" and "Laguna de los Claveles", located in the surroundings of the route. In the descent from Peñalara to La Granja de San Ildefonso, the route runs parallel and close to the Cañón stream and the Carneros stream, and crossing the Morete stream in the k.p. 78.7. From La Granja, passing through Valsaín and Boca Del Asno, and until the k.p. 93, the race takes place near and along the Eresma River, also crossing the Peñalara stream, arriving at the k.p. 87, in addition to other small streams located in the arrival to Puerto de Navacerrada.

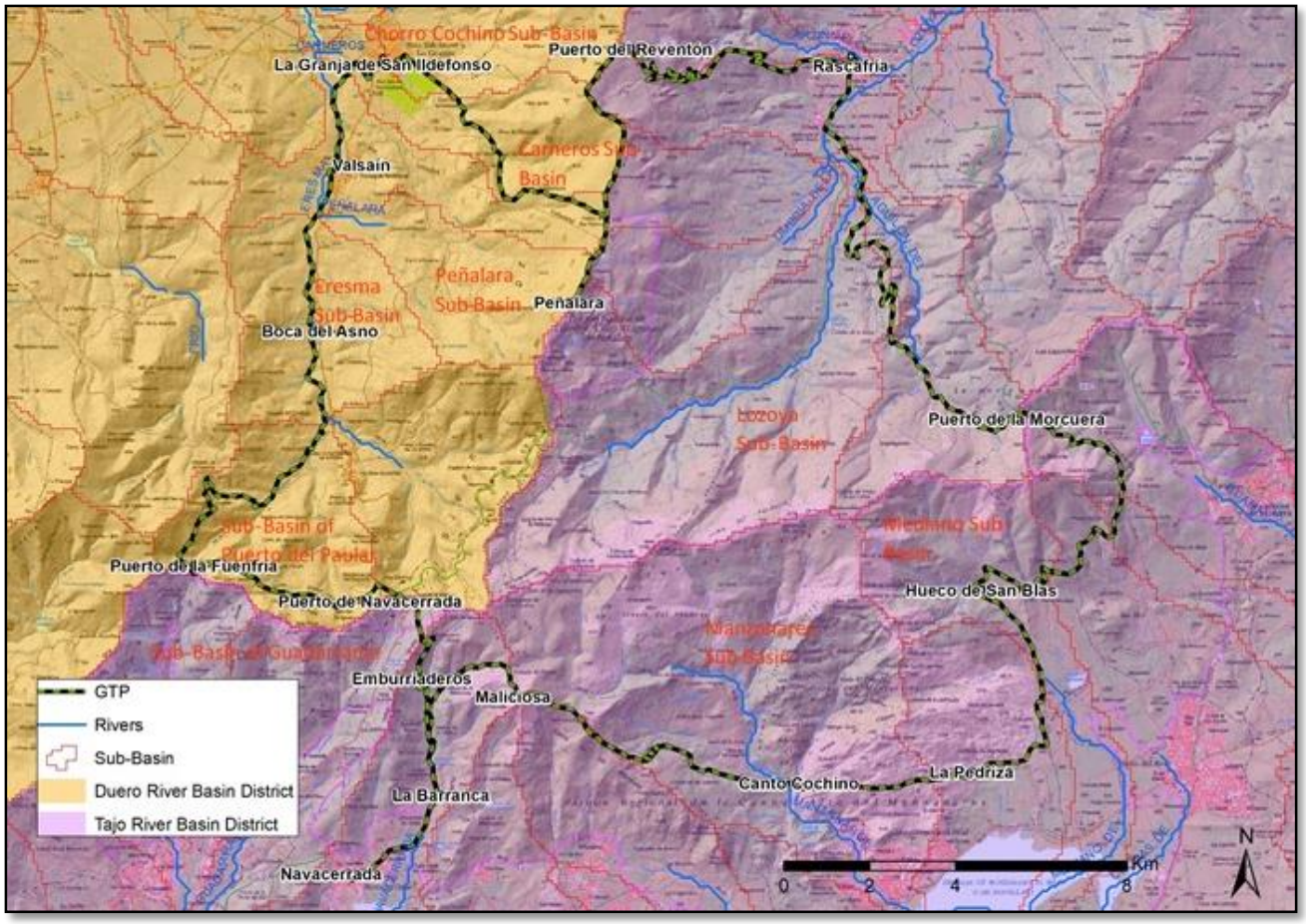

Figure 7. Hydrological map of the Sierra de Guadarrama in the area of the GTP 2018

Apart from the rivers and streams, and as mentioned above, the route passes near wetland areas of glacial origin, belonging to the Tajo River Basin, and which are included in the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat. These wetland areas are epigenetic lagoons, due to the marked impermeable nature of the area substrate (gneiss and granite) and the pluvio-nival regime, since the water comes mainly from precipitation, both rain and snow. They have a high water renewal rate, with a marked acidic-waters character and very weak mineralization. The two lagoons closest to the route are Laguna de los Pájaros, of permanent character, and Laguna Claveles, of temporary character. Due to this permanent character of Laguna de los Pájaros and the existence of a small stream that springs forth in this wetland and flows with permanent flow, even during summer months, certain doubts arise regarding the possible contribution of groundwater, perhaps through a small spring in its bucket, inside any local aquifer of interest.

- Groundwater hydrology

According to the available cartography, there has not been found in the entire area covered by the GTP any important aquifer, except in the part of Rascafría, where an area of dolomitic aquifer is observed. This aquifer is compartmentalized and without regional continuity, and its water is predominantly drained by the rivers or by the springs in the contacts with impermeable materials.

4.1.3. Edaphology

From the edaphological point of view, and taking into account the existing thematic cartography of the Regional Government of Castilla and León and the Community of Madrid, the GTP covers two main soil types according to the FAO classification system:

- Leptosols: Soils that settle on the summits zones, high and average zones, with a steeper topography and steeper slopes or that have developed in a shorter period of time until that moment. These are young soils, which, due to erosive, physiographic and climatic conditions, have experienced a lower level of development than other soils settled in valleys, terraces and hillsides with gentle slopes, where the vegetation type is represented by a greater diversity, with the presence of consolidated phanerophyte forests, areas traditionally used for agriculture, etc. Characteristically, this type of soil has a percentage of fine sands below 10%, which is why they are very stony, with a typical AR or AC profile.
  In the case of the study area, these soils are located on the lithology of an acid character conferred by gneisses and granites. Therefore, within the "leptosols" association it is possible to find the umbric type in this area, with a reduced base saturation. This would be where the leptosols have a certain degree of development (around Puerto De la Morcuera), since most of the leptosols crossing the route are lithic leptosols in which the hard rock is present only a few centimetres from the surface.
  Also around Rascafría, it appears the variety of the mollic leptosols or Rendzinas, which are more typical form areas with basic materials, and which appear here along the limestone strip parallel to the bottom of the Lozoya River Valley.

- Cambisols: The Cambisols, in the area where the GTP runs, lay down on the foothills of the Sierra (Mountain Range), the most softened lands in terms of relief and slopes. They are present in the Navacerrada River valley, in the Manzanares River valley in the area of Canto Cochino, in Hueco de San Blas, the Fosa Del Lozoya (a pit), and the slope of the Eresma River Valley. These soils are more developed than the leptosles cited above. It appears, apart from an A horizon laid down on the original rock substrate, a cambic B-horizon that presents certain conditions of edaphogenic development. Mostly, its genesis comes from colluvium material deposited and alluvial and wind materials deposits, such as those appearing in depressions, channels or streambed, terraces and others.

  These soils do not favour waterlogging since the water surplus usually discharges superficially, so it is complicated in these zones to find areas with saturation characteristics.

4.1.4. Flora and Vegetation

The floristic component of Sierra de Guadarrama, where the GTP is celebrated, is conditioned by the environmental factors previously described (lithological, geomorphological, edaphic, climatic ...).

On the one hand, the siliceous geological substrates that predominantly make up the Sierra de Guadarrama play a fundamental role in the type of plant communities that can be found in this area, such as *Quercus pyrenaica* forests for example. On the other hand, the geomorphology resulting from evolution and the processes that have affected these mountains over time determine different biogeographic enclaves such as the vestiges of glacier activity around Peñalara, the Lozoya depression and other valleys that spread in the geography of the Sierra, the altitudes and exposure of the summits or the isolation of foothills vegetation.

The climate of the Sierra de Guadarrama is determined by its geographical position within the Iberian Peninsula. Most of the rainfall that these mountains receive comes from the storms that enter from the Atlantic and are very worn once they reach the Sierra. The highest areas are those that concentrate the highest rainfall and dry periods of just one month in July-August. In addition, the northern Slope and the southern slope of Sierra de Guadarrama have a different annual rainfall and temperature regime, among other reasons, due to the altitudinal difference between one sector and the other (900 m.a.s.l. in the southern sub-plateau foothills and generally more than 1000 m.a.s.l. in the northern sub-plateau). Thus, on the southern slope rainfall reaches 700-750 mm per year, while the northern slope only reaches 500 mm per year. This determines that, in contrast to other sierras of the Central System which receive another type of climatic influences, Guadarrama is a Sierra with a more xerophilous vegetal landscape, with a great development of pines, junipers and *Cytisus* communities (piornales), in contrast to the broadleaf and the heathlands (Blanco, E. 2013). In relation to these factors, as it has already been mentioned, the Sierra de Guadarrama´s soils usually lack a notable development and, in a large part of these, a high infiltration, but also the climate type determine that most of them are semi-xeric soils, also contributing to the settlement of plant communities such as those previously mentioned. All these factors have also determined the type of management and uses that have occurred throughout history in the Sierra de Guadarrama, and which have also shaped much of the landscape that can be seen nowadays in these mountains. Due to the

soil conditions, cattle ranching and logging have been the main economic activities developed here, as in a large part of this territory the soils do not offer optimal conditions for agriculture. It has been carried out a historical use of oaks for the elaboration of charcoal, the wood of the pine forests, etc.

The Sierra de Guadarrama does not present an exacerbated floristic diversity, but many of the species inhabiting these mountains have particularities that give them some interest. “Due to its location, the Guadarrama flora receives species of different influences or floristic elements. To the mediterranean and mediterranean mountain dominant element, it must be add an important contingent of northern flora, whether boreoalpine, Eurosiberian, Atlantic or temperate” (Blanco et al. 2013). Inhabit in this territory numerous Iberian or Central System endemism such as *Adenocarpus hispanicus* or *Armeria caespitosa*, range-edge and relict species. At a Guadarrama endemisms level, depending on which scientific sources are consulted, it is possible to find different considerations. Some species that could be considered unique from Guadarrama or with a very little presence in sierras and neighbouring mountain ranges, and that could appear in the vicinity of the race, would be *Erysimum humile subsp. penyalarensis*, *Ranunculus valdesii* or *Senecio boisierii*. It is possible to find specimens or even stands of species in enclaves with a special microclimate within the Sierra, such as birches of *Betula pubescens subsp. celtiberica*, refugees in wet and shady areas of the river banks, and common holly copse (*Ilex aquifolium*), or Common Yew (*Taxus baccata*). All these are examples of formations previously spread on a larger scale throughout mountains, thanks to past environmental conditions that were more suitable for them.

Figure 8. Adenocarpus hispanicus from Quercus pyrenaica forests in Rascafría.

Figure 9. Armeria caespitosa in the rock-roses communities of Peñalara surroundings.

It can be distinguished four fundamental floors for which the GTP runs, based on the altitudinal levels of the vegetation floors of Sierra de Guadarrama and its zonation:

- **Plain level-lowlands**: This level includes plant communities that settle in what would be the mesomediterranean bioclimatic belt, and here, in Sierra de Guadarrama, it is mainly formed by forests and agrosilvopastoral system, so-called dehesa, of hold oak (*Quercus ilex subsp. ballota*), Narrow-leafed Ash (*Fraxinus angustifolia*) and Prickly Juniper (*Juniperus oxycedrus*). Within the GTP study area, and due to the scarcity of areas that descend altitudinally to the upper limits of this floor (1000-1200 m.a.s.l.), the representation of these plant communities is restricted to La Pedriza, in which the environmental conditions allow an altitudinal ascent of vegetation that would reach its climax at lower altitudes, and the Berrueco surroundings where it appears the characteristics dehesas, traditionally used for livestock activity. Canto Cochino surrounding would also be suitable places for the development of these formations but, in front of these types of species, nowadays other formations such as the repopulation stands of cluster pine (*Pinus pinaster*), black pine (*Pinus nigra*) and Arizona cypresses (*Cupresus arizonica*) take precedence. The typical scrub from this vegetation floor is formed by species belonging to families such as *Cistus, Fabaceae* (*Retama sphaerocarpa* for example), or *Lamiaceae*. In some areas presenting degradation of forest, the gum rockrose (*Cistus ladanifer*) become important, and in other areas as La Pedriza, laurel-leaf cistus (*Cistus laurifolius*) also goes along with oak and pine forests from this Plain level.

Figure 10. Plain level vegetation in the Berrueco environment.

- **<u>Tree layer of Pyrenean Oak (*Quercus pyrenaica*) and Scots pine (*Pinus sylvestris*)</u>**. This level distinguishes three different types of formations that characterize the Sierra de Guadarrama slopes and follows one another at an altitudinal level from lowest to highest height on the slopes as follow: On the one hand the *Quercus pyrenaica* forest, on the other the supra-mediterranean shady pine forests, and above these two there is the open oromediterranean pine forest (Blanco et al. 2013).
    - In the race area, the *Quercus pyrenaica* forest is represented mainly in the Rascafría surroundings. The trees state of this forest has been modified considerably by the logging carried out in the past. The shrub layer of these forests is mainly represented by *Genista florida* and *Cytisus scoparius* (common broom). In the one in Rascafria it frequently appears *Adenocarpus hispanicus*, endemic specie from the Central System mountain range. In this formations' ground cover can appear *Ranunculus valdesii*, listed as "of preferential attention" in the Regional Catalogue of Endangered Species (CREAM, Catálogo Regional de Especies Amenazadas) and "Vulnerable" in the Decree 63/2007 by which the "Protected Flora Catalogue of Castilla and León" (Catálogo de Flora Protegida de Castilla y León) is created. This species can appear spread by these forest and could be present in the *Quercus pyrenaica* forest of Rascafría, crossed by the race between the k.p. 56.2 and 58.2. This type of forest also goes down altitudinally to Hueco de San Blas area. In addition, the oak appears intermingled as ground cover or dominant in the Scots pine pine forests, especially in the forested formations of the Segovian slope, and in the lower altitude areas crossed by the GTP route.

Figure 11. GTP route stretch crossing the Quercus pyrenaica forest in the tree layer of Rascafría environment.

- The pine forests also show that characteristic of altitudinal differentiation, in their case in the ground cover. On the one hand, at lower altitudes, in what would be the supra-mediterranean belt, there are dense pine forest dominated by the Scots pine (*Pinus sylvestris*). Also common within the formations of this species are stands of *Pinus nigra subsp. Salzmannii* or *Pinus pinaster*, the latter are repopulated, in contrast to the first two, which are formations representing the potential vegetation on the Sierra de Guadarrama slopes, although in many other areas of the GTP also appear as a reforested forest. It should be highlighted that these formations cover a greater section of the GTP route. Its shrub canopy depends on the altitude and density of the forest, but in general it is formed by *Genista florida* and *Juniperus communis*. In addition, the herbaceous substratum, as in the *Quercus pyrenaica* forest, can present *Ranunculus valdesii* in the supra-mediterranean pine forests of La Granja de San Ildefonso (Hernández Palacios, Esteban Resino, & Fernández González, 2007).

Figure 12. Supra-Mediterranean pine forest of Pino albar characteristic of Sierra de Guadarrama (Pinus sylvestris).

In the most sheltered and protected areas, such as the narrowed parts of streams and the most shady pine forest, the conditions facilitate the growth of a canopy of interesting vegetation as *Sorbus aucuparia* or *Ilex aquifolium*, as well as some relictic species (*Betula pubescens subsp. celtiberica*, *Populus tremula* or *Ulmus glabra*) and large fern extensions (*Pteridium aquilinum*) or nemoral species typical from more northern environments.

- The open oromediterranean pine forest also have the Scots pine as a main phanerophyte species, but its cover is much lower, and the *Cytisus purgans* and *Juniperus communis* (supra-forest zone vegetation) become dominant.

Figure 13. Transition zone of the oro-Mediterranean pine forests, with dominance of the scrubs (matorral) of junipers or greenweeds.

As it is already mentioned, the limits established between these formations tend to be diffuse and some areas often could present vegetation from both types.

- **Supra-forest level of mountain scrub formed by hedgehog heath (*Citysus purgans = C. oromediterraneus*) and creeping juniper species association (*Juniperus communis subsp. alpina*)**: This zone starts to predominate around 2000 m.a.s.l. and it presents a scrubland mainly formed by these two species. It corresponds to the plant association *Senecioni carpetani - Cytisetum oromediterranei*. In the stretch of the race that goes through the Peñalara Massif and the Montes Carpetanos it is accompanied occasionally by *Adenocarpus hispanicus*, a fact that does not correspond to the stretch around Collado Del Piornal, La Maliciosa, Sierra de los Porrones or Puerto de la Morcuera.

- **<u>High mountain psychro-xerophilic grasslands</u>**: This type of grassland extends through the highest areas of the summits and clearcut scrubland areas from supra-forest zone. It is especially relevant since it presents a large part of the endemic and most threatened species of the Sierra de Guadarrama. Along with the domain of the psychro-xerophilic grasslands, the environmental conditions of snow making, hydromorphy or topography play a fundamental role for the appearance of other types of habitats and formations such as peat bogs, thalweg, rocky areas or scree. This type of habitats appear mainly between the Puerto Del Reventón and the Peñalara summit, as well as in the Maliciosa summit surroundings. These grasslands are dominated by *Festuca curvifolia* and *Hieracium vahlii*, some interesting species such as *Gentiana lutea* (of special interest in CREAM, Regional Catalogue of Endangered Species) both in the Maliciosa surroundings (Oñorbe, 2015) and in Peñalara mountain range (Montouto González, 2002), settled in rocky areas (Documento III: Parque Natural de Peñalara y Área de Influencia Socioeconómica. CARTOGRAFÍA DE UNIDADES DE VEGETACIÓN. , 2008). There are also citations of *Erysimum humile subsp. penyalarensis* (Endangered on the Red List of Spanish Vascular Flora) in the psychro-xerophilic grasslands of Risco de los Pájaros.

Figure 14. Gentiana lutea.

Figure 15. Erysimum humile subsp. penyalarensis.

During the fieldwork in the mountain range sector between Peñalara summit and Puerto de la Morcuera, a few interesting species were identified, such as *Armeria caespitosa* or *Sedum brevifolium*, and *Saxifraga pentadactylis subsp. Willkommiana*.

Figure 16. Armeria caespitosa in the route, in Risco de los Pájaros surroundings.

Figure 17. Saxifraga pentadactylis subsp. Willkommiana in rocks from Altos de Poyales.

Figure 18. Sedum brevifolium in rocks from Peñalara range.

Another species to be highlighted is the Iberian endemism *Senecio boissieri*, which can appear in the mountain range from Peñalara peak to Cerro Claveles.

Figure 19. Senecio boissieri

4.1.5. Fauna

In the Sierra de Guadarrama there is a great variety of species, representing 40% of the total fauna of Spain and 18% of the European fauna. This species richness is very high, especially in the northern part of the route, when it runs through areas near Peñalara.

The number of taxa of vertebrate registered is 255, which include mammals (57), followed by amphibians and reptiles (38), birds (143) and, finally, fish (17). Regarding to invertebrates, the available data are much more limited and partial, since only for insects group the available figures are about 2,000 species in Sierra de Guadarrama, when there are estimations of about 14,000.

Below are described the different species of vertebrates, classified in classes, and invertebrates that may appear in the areas where the race takes place or close to it.

- **Mammals:**

In summit areas inhabits, and breeds during the weeks of the celebration of the GTP, the snow vole (*Chionomys nivalis*), a species catalogued "of special interest" in the CREAM, and which shows predilection for rocky areas and screes. It also appears other bigger mammal like the Iberian wild goat (*Capra pyrenaica*).

Figure 20. Snow vole (Chionomys nivaliscorzos). Source: Sierra de Guadarrama N.P.

Figure 21. Wild goats the Pedriza range surroundings.

On the other hand, in grassland areas, pine forest or broadleaf forest, can be highlight mammals such as European roe deer (*Capreolus capreolus*), the wild boar (*Sus scrofa*), the beech marten (*Martes foina*) and the wildcat (*Felis silvestris*) of special interest in Madrid and Spain. In the Pyrenean oak forest, also appear the snow vole (*Chionomys nivalis*), the European badger (*Meles meles*), the wood mouse (*Apodemus sylvaticus*), European hedgehog (*Erinaceus europaeus*) or the greater white-toothed shrew (*Crocidura russula*).

Regarding to understory and gallery forests areas, the most characteristic mammals are common otter (*Lutra lutra*), listed as "endangered " in the CREAM, and several species of bats catalogued as "vulnerable" in the CREAM: the Mediterranean horseshoe bat (*Rhinolophus euryale*), the grey long-eared bat (*Plecotus austriacus*), the lesser horseshoe bat (*Rhinolophus hipposideros*) and the greater mouse-eared bat (*Myotis myotis*).

- **Amphibians:**

It has been listed 15 species of amphibians in SIerra de Guadarrama, from which 5 of them are Iberian endemisms.

Some "species of interest" such as the common midwife toad (*Alytes obstetricans*), and some classified as "vulnerable" such as the Iberian frog (*Rana iberica*), or the European tree frog (*Hyla arborea*), can live in high areas of the river bed or pine forest with streams. For this three species the reproductive period covers the days on which the race is celebrated, and in order not to damage possible lays in the streams and humid environments, special attention should be paid to the signposting of fords to minimize the runners trampling inside the stream water.

Figure 22. European tree frog (Hyla arborea). Author: Jaime Bosch.

Of special mention is the Alpine Newt (*Mesotriton alpestris*), whose level of threat according to the CREAM is "in danger of extinction", and "vulnerable" according to the Spanish Catalogue of Endangered Species. Its habitat are lagoons areas and it could appear in peat bogs. Although the race does not directly cross any of these areas, it will be recommended to avoid crowding of runners in the vicinity of the route crossing close to these habitats. Such points are a stream source in a thalweg (k.p. 65.5) between Puerto del Reventón and Alto de los Poyales, or in Laguna de los Pájaros (k.p. 69.9).

Figure 23. Alpine Newt (Mesotriton alpestris) Author: Jaime Bosch.

In areas of higher stream flow, with cleaner and well oxygenated water courses, it is possible to find the Iberian newt (*Lissotriton boscai*), catalogued as "of special interest" in the CREAM. The period in which the clutch are still on the terrain could coincide with the race route, if the lay is delayed. A correct signposting and surveillance of the streams or the placement of rocks or boards that avoid the runners trampling in the water will be necessary to avoid damages in possible clutch of eggs in the fords.

- **Reptiles:**

With regard to the reptile group, 23 species have been inventoried in the Guadarrama National Park. In the most rocky areas of the summits, the species that stand out the most are the *Iberolacerta cyreni*, endemic reptile of the Central System, and the Common Wall Lizard (*Podarcis muralis*), both of them catalogued as "vulnerable" by CREAM.

Figure 24. Iberolacerta cyreni

Figure 25. . Podarcis muralis

Meanwhile, in forest area, it can be find species such as the Iberian Emerald Lizard (*Lacerta schreiberi*), catalogued as "of special interest" at both national and regional (Madrid) level, and which usually frequents the banks of rivers and streams. Deterioration and destruction of river banks is one of the threats that carry weight on this species, and regarding to the race, the erosion impacts in the channels and the watercourses must be minimized in order to favour the conservation of its habitat.

- **Birds:**

It has been inventoried around 143 different species of birds with regular presence during some period of the year in Sierra de Guadarrama. In this environmental inventory will be named the most important ones, both for their level of protection and for the possible presence in areas close to the race and the coincidence of its date in its breeding season.

In high mountain areas, with rocky environments and sparse vegetation as La Maliciosa surroundings and the Peñalara mountain range, is possible to find some nesting birds "of special interest" in the CREAM, such as the alpine accentor (*Prunella collaris*), the black wheatear (*Oenanthe leucura*), the red-billed chough (*Pyrrhocorax pyrrhocorax*) or the bluethroat (*Luscinia svecica*). All of them start their breeding season one or two months before the race, but usually it ends around June. With an adequate signposting that does not run along little frequented paths and the follow-up by the corridors of that signposting, no impact should be generated on these species.

Figure 26. Alpine accentor (Prunella collaris). Source: Sierra de Guadarrama N.P.

In addition, there inhabit some important raptors with similar breeding seasons, such as the Golden Eagle (*Aquila chrysaetos*), catalogued as "sensitive to the alteration of its habitat". On the other hand, some species with earlier breeding seasons are the Peregrine Falcon (*Falco peregrinus*), and the Bonelli's Eagle (*Hieraetus fasciatus*), catalogued as "vulnerable" by the CREAM. All these species nest in vertical rock walls with cracks and hollows such as those on the south face of La Maliciosa, Sierra de los Porrones or the Peñalara mountain range, especially on Risco de los Pájaros and the south face of the Peñalara Massif. Another species that can nest in these rocky environments is the Griffon vulture (*Gyps fulvus*), "of special interest", although this species can also be located in lower areas and nest on trees. To avoid afflictions to populations of these species in the environment of the race, it should be avoid sources of unusual noise or excessive crowds of the public.

In the transitional belt between the woodlands and the alpine scrubland and pastures, it appears the Citril finch (*Carduelis citrinella*), "of special interest" by the CREAM. The celebration of the GTP coincides with its breeding period.

Regarding to the species living in pine forest, deciduous forest or *Quercus pyrenaica* forest, it is important to highlight, following their special interest in the Madrid catalogue, the Booted eagle (*Aquila pennata*), the Short-toed eagle (*Circaetus gallicus*), the Western orphean warbler (*Sylvia hortensis*), and the Common kingfisher (*Alcedo atthis*) that can also appear near to wet areas like ponds, rivers or streams.

It is also important to mention in these pine forests other species such as the Red kite (*Milvus milvus*), the Spanish imperial eagle (*Aquila adalberti*), the Black vulture (*Aegypius monachus*), with breeding colonies in the Valleys of Lozoya and Valsaín, and the Black stork (*Ciconia nigra*). They are catalogued as "vulnerable" or "in danger of extinction" in both the CREAM and the Spanish Catalogue of Endangered Species. The breeding periods of all of these birds are usually lasts until June or later. The race stretch crossing the pine forests that inhabit these species are, with a few exceptions, relatively frequented homologated trails or forest path. The pine forests of Montes de Valsaín are a very important area for the distribution of these species. Information about possible affectation to fauna in this stretch of the route was requested to the Ministry of Environment of Castilla and León.

The response was received by the Territorial Service of Environment of Segovia, saying there was not potential affection to them.

Figure 27. Spanish imperial eagle (Aquila adalberti). Source: MAPAMA.

Figure 28. Black vulture (Aegypius monachus) Author: Javier de la Puente.

Another habitat where is possible to find species of interest catalogued nationally are grasslands and meadows, with species such as the Whinchat (*Saxicola rubetra*), the Southern grey shrike (*Lanius meridionalis*) and the Barn owl (*Tyto alba*), all of them catalogued "of special interest " by the CREAM and whose breeding periods coincide with the celebration of the GTP, and another catalogued as "vulnerable" as is the White stork (*Ciconia ciconia*). Only in the surroundings of the Berrueco is possible to find these kind of habitats, with very short stretch of the GTP route. Once again, the loud noises and anomalous to the environment that might be a nuisance to the species that can nest near the GTP route should be avoided. Finally it must be point out the species living in understory and gallery forests, near wetlands such as rivers, ponds or streams, and, in this case, catalogued "of special interest" both by the CREAM and the National Catalogue. These species are the Common sandpiper (*Actitis hypoleucos*) and the White-throated dipper (*Cinclus cinclus*). These species nest in

the vicinity of rivers and streams and, if the breeding period is late, it can coincide with celebration of the race. Among the factors that can diminish the success of their laying there is the discomfort due to human presence. It will be advisable to avoid noise and crowds of people in environments close to the fords to reduce the impacts on these species.

- **Invertebrates:**

Invertebrates are the group with the highest number of species in Sierra de Guadarrama. They are species with very variable adaptive strategies, and high diversity and adaptability to the climatic conditions of the environment in which they inhabit.

It is worth highlighting among all of them species "in danger of extinction" according to the CREAM, such as the mountain Apollo (*Parnassius apollo*), whose potential habitat is the psychro-xerophilous grassland with plant species of the Sedum, and which was found abundantly during the fieldwork in Peñalara area, and it also appears in the grasslands of La Maliciosa surroundings.

Figure 29. Mountain Apollo (Parnassius Apollo). Source: Hablando en verde webpage.

It is also important in this category of "in danger of extinction" by the Madrid catalogue the *Orthoptera Podisma carpetana subsp. carpetana*, only known in Sierra de Guadarrama and whose preferential habitat is the high mountain *Cytisus* communities (piornales). The Mother-of-pearl blue (*Plebicula nivescens*) is another species of Lepidoptera, catalogued as "sensitive to the alteration of its habitat" and also endemic to this area, along with *Iberodorcadion hispanicum* or some endemic species of *Cerambycidae*, living in grasslands. In the high areas of the bed of rivers and streams can be find insect larvae, especially *Plecoptera* and *Trichoptera*, and one remarkable species such as *Allogamus laureatus*, "sensitive to alteration of the habitat" according to the CREAM.

On the other hand, in the pinewood areas the most outstanding species is the Spanish Moon Moth (*Graellsia isabelae*) catalogued "of special interest" by the CREAM and endemic to Sierra de Guadarrama, and in forests of Pyrenean oak the Stag Beetle (*Lucanus cervus*), "vulnerable" in the Community of Madrid according to CREAM. For this last one, the impact would not be significant since the clutch are in holes of dead trees, although it would be advisable that in *Quercus pyrenaica* forests the pass of runners through consolidated paths, to avoid damage by trampling larvae.

Figure 30. Stag Beetle (Lucanus cervus) Author: Ignacio Granados.

Figure 31. Moon Moth (Graellsia isabelae). Author: Ignacio Granados.

4.1.6. Legal and Conservation context

The context of the race is assigned to territories belonging to both the Community of Castilla and León, specifically Segovia province, and the Community of Madrid. The GTP route goes through the following municipalities: Navacerrada, El Boalo, Manzanares el Real, Soto del Real, Miraflores de la Sierra, Rascafría, San Ildefonso and Cercedilla.

Protected Natural Areas, Natura 2000 network, and other protection figures and management tools, both regional and state, are the ones regulating activities in Sierra de Guadarrama, and making them compatible with the high ecological value of its natural environment.

The list of operative protection figures within the territory crossed by the GTP are the following (See appendix 1):

- Guadarrama National Park. Due to the prorogation of the approval of the Usage and Management Master Plan (Plan Rector de Uso y Gestión), the National Park administration decided to establish a series of criteria for the regulation of sports competitions within the Park:

    - The number of participants must be limited to 450 people.
    - Cross country running type will be not allow.
    - The project presented by the event organizer, before the celebration of it, should contain mitigation and conservation measures in order to obtain an imperceptible impact on the natural environment.
    - Awareness raising measures towards the natural environment for the participants will be promoted.
    - It will be mandatory to start and finish the sporting event (trail running in this case) inside an urban area, i.e. in a village, which should presents guarantees of sufficiency for the necessary logistics of the race (car park, toilets/restrooms, catering and supply ...).

- Natura 2000:
    - Special Area of Conservation ""“Cuenca Alta del Río Manzanares” (Madrid).

    Among the points of the Decree 102/2014 of declaration of this SAC, it must be highlighted, in relation to the mountain races, the following indication:

    "The continued and intensive effect of trampling off the trails can cause an alteration of the plant communities´ structure constituting certain habitats.

    - Special Area of Conservation “Cuenca del Río Guadarrama” (Madrid).

    Among the points of the Decree 105/2014 of declaration of this SAC, it must be highlighted, in relation to the mountain races, the following indications:

    "The Protected Area hosts an important recreational activity mainly focused on hiking, mountain biking and recreation in equipped areas for it."

    "Hiking is one of the most important leisure activities in the Protected Area. The intensive practice of this activity could affect various types of Habitats of Community Interest, to cause a loss of the habitats´ quality of certain species covered by this Plan or even cause discomfort in certain phases of the biology of these species. In the same way, the continued and intense trampling off the paths, can cause an alteration of the plant communities' structure constituting certain habitats. "

    "... the intensive recreational use that takes place in certain zones of the area, such as recreational areas or areas close to urban centers, can generate accumulation of all types of waste."

    - Special Area of Conservation “Cuenca del Río Lozoya y Sierra Norte” y Special Protection Area “Alto Lozoya” (Madrid).

    Among the points of the Decree 103/2014 of declaration of this SAC, it must be highlighted, in relation to the mountain races, the following indications:

"The continued effect of the hikers´ trampling off of the trails can cause an alteration of the plant communities´ structure that may affect the plant and animal species associated with them."

- Special Area of Conservation and Special Protection Areas (SPAs) "Sierra de Guadarrama" (Castilla y León).

There has been no developed a specific management plan for these Natura 2000 area.

- Habitats of Community Interest:
  - 4030 European dry heaths: This type of habitat with shrub formations of medium to low size with predominance of *Calluna vulgaris*, formations of *Erica spp*., *Genista* and *Cistaceae*, appear by in the descent part from Emburriaderos to La Barranca, and in the Maliciosa summit.
  - 4090 Endemic oro-Mediterranean heaths with gorse: These mountain bushes from the massifs appear extended in large part of the route. They occupy areas around Collado del Piornal and Maliciosa, from the Puerto de La Morcuera to Rascafría, and continue through the Puerto del Reventón, as well as in the downhill from La Granja de San Ildefonso by Valsaín to Puerto de la Fuenfría.
  - 5120 Mountain *Cytisus purgans* formations: Also very predominant throughout the route are these brooms of *Cytisus purgans*, which can be found in Emburriaderos, La Maliciosa, Puerto de la Morcuera, Puerto del Reventón, Puerto de la Fuenfría and Puerto de Navacerrada.
  - 5210 Arborescent matorral with *Juniperus spp*: Open bushes dominated by Juniperus species are located in the southernmost part of the route, around Puerto de la Fuenfría, Puerto de Navacerrada, Emburriaderos and the Maliciosa summit.
  - 6160 Oro-Iberian *Festuca indigesta* grasslands: These permanent herbaceous communities or substitutes for permanent creeping junipers, are dominated by species and subspecies of the *Festuca indigesta* group. This type of habitat appears by the Puerto de la Fuenfría, Puerto de Navacerrada, Emburriaderos and the La Maliciosa summit, as well as in Puerto Del Reventón and close to the Peñalara summit.
  - 6220 Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*: This type of habitat are Mediterranean xerophile, mostly open, short-grass annual grasslands rich in therophytes, and classified as a Priority Habitat. It can appear, according to the existing cartography, in certain areas of the descent from Puerto de la Morcuera to Rascafría, in Puerto Del Reventón, and in the area of Valsaín and Puerto de la Fuenfría. After the fieldwork and the particular study of each one of the zones through the environmental cartography, it can be affirmed that the route of the GTP in particular does not cross any formation of this type or it does it by forest path, so there is no impact contemplated for this habitat type.
  - 6230 Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe): These type of grassland formations are classified as Priority Habitat. In relation to the route of the race, very specific stretches

would cross formations of this type, as it is indicated in the following section "potential impacts and corrective measures" of this thesis.

- 6420 Mediterranean tall humid grasslands of the Molinio-Holoschoenion: Mediterranean humid grasslands of tall grasses and rushes, which appear scarcely in the area of Canto Cochino.
- 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels: Wet and nitrophilous tall herb edge communities, present only in a small area near Rascafría.
- 6510 Lowland hay meadows (*Alopecurus pratensis, Sanquisorba officinalis*): This type of habitat, which also appears in the area of Rascafría, are species-rich hay meadows on lightly to moderately fertilised soils.
- 8130 Western Mediterranean and thermophilous scree: Screes of warm exposures typical from Mediterranean mountains, hills and lowlands, such as Puerto de la Fuenfría, La Maliciosa and areas of Peñalara summit, with scattered vegetation that takes root among the rocky fragments.
- 8220 Siliceous rocky slopes with chasmophytic vegetation: Vegetation of fissures of siliceous inland cliffs that appears in summits areas such as Peñalara and Puerto de la Fuenfría, and Boca de Asno, La Maliciosa, Canto Cochino and Hueco de San Blas.
- 8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo albi-Veronicion dillenii: Siliceous rock with predominance of *Sempervivum* genre species that appears by Boca del Asno and Canto Cochino.
- 91B0 Thermophilous *Fraxinus angustifolia* woods: Iberian narrow-leaved ash woods (*Fraxinus angustifolia*) typical from soils with a certain humidity, which appear in Boca Del Asno and certain areas on the trail to Rascafría.
- 92A0 Salix alba and *Populus alba* galleries: Riparian forests dominated by *Salix alba, Salix fragilis* or their relatives, which appear in areas of Rascafría, Canto Cochino, and on the ascend by Boca del Asno to the Puerto de La Fuenfría.
- 9230 Galicio-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica*: Forests of acidic substrates dominated by *Quercus pyrenaica*, sometimes in mixture with the, *Q. robur*. This type of habitat appear in Navacerrada, halfway between Puerto de la Morcuera and Rascafría, and between Rascafría and Puerto Del Reventón, as well as in the ascent from La Granja de San Ildefonso to Boca del Asno.
- 9340 *Quercus ilex* and *Quercus rotundifolia* forests: Sclerophillous forests dominated by holm-oak (*Quercus rotundifolia*) that appear in areas of Canto Cochino and La Pedriza.

- Cuenca Alta del Manzanares Regional Park (Madrid)
  In the Usage and Management Master Plan (Plan Rector de Uso y Gestión, PRUG) of this area there is no reference to mountain races or other activities that can be related to any of the potential impacts.

- Natural Park “Sierra Norte de Guadarrama” (Segovia y Ávila).
  The Natural Resources Management Plan of this area does not include any information or point that regulates a sporting activity such as mountain races.

- Natural Resources Management Plan (PORN, Plan de Ordenación de recursos Naturales) of Sierra de Guadarrama (Madrid).

  In the part belonging to Madrid, and outside the limits of the National Park, in regard to mountain races, it is applied the legislation included in the PORN of Sierra de Guadarrama. It must be highlighted among its points the following information:

  "... the event organizer must take the necessary measures in order to ensure the compliance of the following conditions:

  a) The absence of negative impacts on natural resources (soil, water, fauna, flora, vegetation, etc.).

  b) The dismantling of all infrastructures and auxiliary equipment of a provisional nature that must be installed, as well as executing the corrective measures that may be necessary to limit the environmental impacts or alterations produced by the celebration of the sports event.

  c) Setting-up the technical and financial guarantees that, in its case, the competent environmental authority considers necessary to fulfill the previous conditions or other that can be established. "

- Woodlands of Public Benefit (MUP = Montes de utilidad pública)

  The route cross through several Woodlands of Public Benefit, both from the Community of Madrid and the Community of Castilla and León. Those MUP for which the GTP crosses are named below.

  From Navacerrada and Emburriaderos until reaching Peñalara summit, the race crosses through the following MUP (Community of Madrid):

  1. MUP nº 33: "Pinar Baldío" property of City Council of Cercedilla and Navacerrada.
  2. MUP nº 24: "Pinar de la Barranca" property of Navacerrada City Council.
  3. MUP nº 197: "Los Almorchones" property of Community of Madrid.
  4. MUP nº 143: "El Risco" property of Community of Madrid.
  5. MUP nº 198: "El Boalo" property of Community of Madrid.
  6. MUP nº 163: "La Camorza" property of Community of Madrid.
  7. MUP nº 199:" Las Pedrizas, El Rincón y El Jaralón" property of Community of Madrid.
  8. MUP nº 142: "Hueco de San Blas" property of Community of Madrid.
  9. MUP nº 141: "Perímetro Aguirre" property of Community of Madrid.
  10. MUP nº 140: "Perímetro Aguirre" property of Community of Madrid.
  11. MUP nº 13: "La Sierra, La Raya, Las Dehesas y otros" property of Miraflores de la Sierra City Council.
  12. MUP nº 151: "La Morcuera" property of Community of Madrid.

13. MUP nº 114: “Los Robledos” property of Rascafría City Council.

14. MUP nº 153: “Las Calderuelas y otros” property of Community of Madrid.

15. MUP nº 1: “Llanos de Peñalara y Laguna de los Pájaros” property of Community of Madrid.

From Peñalara summit to the end of the race in Navacerrada, the GTP crosses through the following MUP (Castilla and León):

16. MUP nº 264: “Peñalara-Nevero” property of Community of Castilla and Leon.

17. MUP nº 2: “El Pinar de Valsaín” property of the Autonomous Organization "National Parks".

18. MUP nº 1: “Las Matas de Valsaín” property of the Autonomous Organization "National Parks".

- Important Bird and Biodiversity Area (IBA).
  It is a conservation program developed by the BirdLife partner’s network, whose main objective is the identification, conservation and management of the essential areas for birds worldwide. Although it has no legal linkage, it is interesting the information provided regarding the sensitivity of these enclaves as habitats for poultry fauna. Within the area crossed by the GTP, there are two areas included in the inventory of Important Bird Areas (IBAs) in Spain:
  - Alto Lozoya-La Pedriza: Important area for forest raptors. It covers the entire area covered by the race in its part of the journey through the Community of Madrid.
  - Umbria de Guadarrama: Important area for breeding raptors. In the province of Segovia, it covers the entire stretch of route passing through this province.

- Drovers' road.
  Among the points to highlight in reference to mountain races in Law 3/1995, of March 23, of Drovers' road, it is indicated that:
  "In accordance with the article 14 may, it can be established detachable installations necessary for the practice of these activities on the drovers' road areas (as long as those occupations do not alter the livestock transit, nor prevent other compatible or complementary uses, and with a duration of less than ten years). For this, it will be necessary a report from City Council and authorization of the Autonomous Community.

  In case some uses in drovers' road areas can be incompatible with the protection of sensible ecosystems, forest masses in high risk of fire, protected species and traditional sport practices, the competent Administrations will be able to establish certain temporary restrictions to the complementary uses."

  With regard to the drovers' road crossed by the GTP in the Community of Madrid and the Community of Castilla and León, they are listed below:
  - In the area of Canto Cochino, k.p. 17: Cordel de Campuzano, Vereda de los Mesones and Descansadero, Descansadero de Canto Cochino, and Descansadero de los Mesones.
  - Area of La Pedriza, from k.p. 17 to k.p. 24: Cordel de la Pedriza.
  - From k.p. 24 to k.p. 25.5: Cordel de Prado Herrero.

- From k.p. 25.5 to k.p. 26.5: Cordel del Arroyo Mediano que baja de la Sierra.
- From k.p. 26.5 to k.p. 29 (Hueco de San Blas): Cordel de Prado Herrero.
- Arriving to k.p. 39 (Puerto de la Morcuera): Cordel del Puerto de la Morcuera y Descansadero San Blas y de la Parada del Rey.
- From k.p. 97 (Fuente de la Reina) to k.p. 99.5 (Puerto de la Fuenfría): Cordel de Santillana.

- Singular and monumental tres.
  There is no specimen catalogued by the Autonomous Communities of Madrid and Castilla and León along the GTP route.

- Biosphere Reserve “Cuenca Alta del Manzanares”.
- Biosphere Reserve “Real Sitio de San Ildefonso-El Espinar”.

4.2. Potential impacts: Ecologically Sensitive Areas (ESA)

After the recognition and study on digital cartography, fieldwork and literature review of the wide information available about the area, two Ecologically Sensitive Areas (ESA) have been established along the 116 kilometers of the GTP race. These Ecologically Sensitive Areas (ESA) are the ones having the ecological or physical elements of greatest interest and that can potentially suffer more affection due to the celebration of the race. These two Ecologically Sensitive Areas (ESA) are the following:

- **Ecologically Sensitive Area (ESA) 1:** Pine forest from La Barranca (round-trip), Collado del Piornal, Maliciosa, Collado de las Vacas, Sierra de los Porrones.

- **Ecologically Sensitive Area (ESA) 2:** Rascafría-Peñalara-San Ildefonso.

At the same time, described below are the differentiated types of potential impacts that could occur on the natural environment of the GTP and which are described specifically for ESA 1 and 2 together with the attached cartography (See appendix 2).

4.2.1. Risk of soil erosion and soil compaction.

It is considered that the only sections on which there could be a risk of erosion and compaction are those crossed by trails, leaving out of this potential impact for the paved areas, forest path or forest road.

Specifically, areas where trails are diffused or branched, as well as those in a highly degraded state, indicated in the cartography as "diffuse network and risk of erosion", are those that would present a greater potential impact regarding the increase in erosion processes due the trampling of runners and presence of public.

- **Ecologically Sensitive Area (ESA) 1:**

There is a stretch of the trail which presents bifurcations and ramifications between the k.p. 5 and k.p. 5.3 in the pine forests of La Barranca. Moreover, between the k.p. 6.5, where the PR 26 path leaves the pine forests of La Barranca on the way to Collado Del Piornal, and the k.p. 9.5, where the PR 16 path arrives at Collado de las Vacas, the trail has continuous ramifications and numerous adjacent paths. There is also a stretch with high degradation in the surroundings of the Sierra de los Porrones, between the k.p. 10.7 and k.p. 11.6.

Figure 32. Stretch of descent from La Maliciosa, around Collado de las Vacas.

Figure 33. Diffuse trail stretch in Sierra de los Porrones.

In addition, the section included between k.p. 7.7 and k.p. 8.2 presents a diversion of the approved paths PR 26 and PR 16 connecting at Collado del Piornal, and takes a shortcut through a series of very diffuse or even absent trails which crosses the pastures and high mountain scrub.

In k.p. 12.7 before the 150 meters zig zag trail, the route takes a shortcut along a highly degraded path. In the area of descent from Emburriaderos to La Barranca, the race runs along the PR 17 trail, which presents some areas susceptible to erosion and diffuse path stretches. In addition, in the k.p. 110.7 the route takes a shortcut to the forest path of the PR-M 26, which can present these same problems of remarkable erosion (figure 34).

Figure 34. Shortcut of the forest path on k.p. 110.7.

- **Ecologically Sensitive Area (ESA) 2:**

Between the k.p. 55.5 and 55.8 the forest path, which leaves Rascafría urban centre, becomes a diffuse trail network through a sheepfold grassland (figure 35) that extends until the beginning of the *Quercus pyrenaica* forest. Moreover, along the stretch of ascent to Puerto Del Reventón by the *Quercus pyrenaica* forest and pine forests, there are several sections or concrete points where the path presents a remarkable diffuse network. In particular, areas sensitive to this problem appear in the *Quercus pyrenaica* forest between the k.p. 56.7 and 56.8, k.p. 57 and 57.2, and the k.p. 57.6 and 57.8 where, in addition, the trail appears with an appreciable degree of deterioration. In the pine forest it can be found a ramification of the path at the k.p. 58.1. In these stretches it is possible to find *Adenocarpus hispanicus*, *Quercus pyrenaica* seedlings or specimens of the genus *Erica*, which increases the ecological interest of these trail stretches.

Figure 35. Ramification and diffuse trail network in the sheepfold grassland (k.p. 55.5).

Figure 36. Ramification in the trail through the Quercus pyrenaica forest at k.p. 56.7.

Figure 37. Stretch of a degraded path at the end of the Quercus pyrenaica forest (k.p. 57.7).

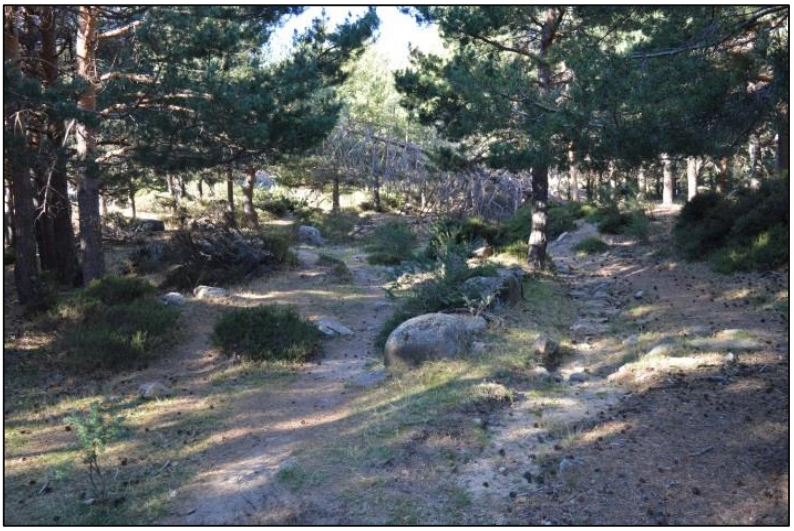

Figure 38. Bifurcation and diffuse network in the path of the pine forest (p.k. 58.1).

The mountain passes crossed by the GTP are areas where paths diverge, blur or disappear and the passage of all the runners along different paths at these points could cause a special degradation impact on the soil. This is the case, in this ESA 2, of Puerto Del Reventón (k.p. 63.7) and Puerto de los Neveros. In the latter, the runners make their way twice (k.p. 68.6 on the way up to Peñalara summit, and k.p. 73.3 on the way down).

Figure 39. Absence of marked path in the pass by Puerto del Reventón (k.p. 63.7).

Figure 40. Diffuse network in the pass by Puerto de los Neveros according to the view of the return way. The signposting will be done by the path on the right and it will make a turn to continue the descent behind the information boards (p.k. 73.3).

In addition, in the mountain range that runs through the peaks and crests between Puerto de los Neveros and Peñalara Summit, there is a continuous ratification of the paths. Some sections present a certain degradation state, and even the route can cross some areas through the pastures and bushes where the path is absent.

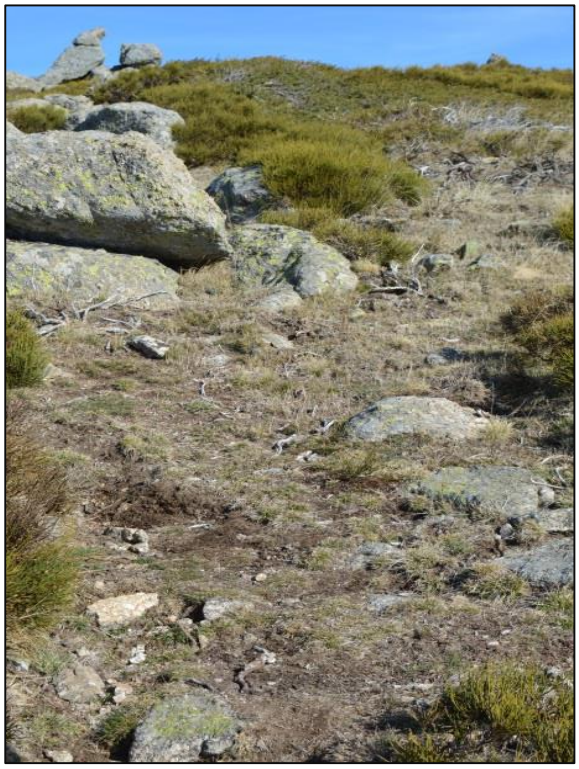

Figure 41. Degraded path in k.p. 64.4.

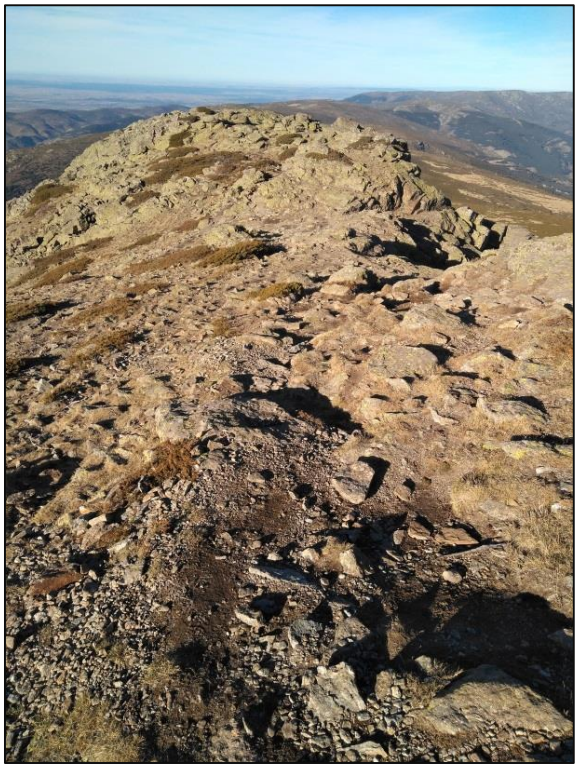

Figure 42. Undefined path around Risco de los Pájaros (k.p. 70.1 for the outward journey and 71.9 for the return way).

Figure 43. Absence of path in the surroundings of Peñalara summit (k.p. 69.9 for the outward journey and 71.1 for the return way).

Already on the descent to La Granja de San Ildefonso, the route crosses a scrubland area where the trail forks and ramifies several times along 300 meters, shortly after leaving Puerto de los Neveros. In addition, one of the pine forest clearings (k.p. 74.3) crosses a grassland in which the path is practically absent. Finally, just before reaching the ford of Arroyo de los Carneros stream (k.p. 76.9 to 77) there is a diffuse path network crossing the pine forest.

Figure 44. Bifurcations and ramifications of the descent path from Puerto de los Neveros (k.p. 73.7).

Figure 45. Scarcely marked path in the Clearing of the Accident (k.p. 74.3).

Figure 46. Diffuse trail network in the pine forest (k.p. 77).

4.2.2. Waste generation

Thrown of garbage and waste generated by the runners, public, organizers and staff, is an evident problem in mountain races and other types of sporting events celebrated in natural areas. In addition, it must be taken into account that the arrows and signalling elements of the race are alien elements to the environment.

4.2.3. Damage to flora and fauna by trampling of runners off of the trails

- **Ecologically Sensitive Area (ESA) 1:**

The route in the ESA 1 presents a couple of interesting vegetation areas which are susceptible to damage by trampling off of trails. One is the Emburriaderos meadow in the k.p. 107.2 (figure 47). It is an area of paths connection, very frequented by hikers. The other is the surroundings of La Maliciosa peak (k.p. 7.6 to 9): Area with presence of psychro-xerophilic grassland and screes can be home to species of flora and fauna of interest, as indicated in the inventory of flora and fauna, such as *Parnassius Apollo* and its nutrient plant Sedum sp. In addition, in the section of ascent to Collado del Piornal there is an area with the presence of the Habitat of Community Interest 6230, classified as Priority, and associated with the spring of the stream Arroyo del Cancho Negro, in the k.p. 7.5.

Figure 47. Meadow in Emburriaderos, usually frequented by large number of hikers.

- **Ecologically Sensitive Area (ESA) 2:**

Impact of runners trampling the terrain has special significance in this Ecologically Sensitive Area. As has already been mentioned in the environmental inventory, the high mountain psychro-xerophilic grassland, the *Festuca curvifolia* grassland, the scree or the environment of summits associated with higher humidity retention soils, are habitats for numerous endemic vascular plant species and "of interest" due to their need for conservation.

In the thalweg and some hills of the mountain range going to Peñalara, the soil can present less xeric conditions and more favourable for the establishment of the *Nardus oromediterraneus* grasslands.

These formations define the Habitat of Community Interest 6230, of priority interest. They appear in the race area on k.p. 64.6, marked in the cartography also as wading, and in the k.p. 66.8. There is also a small fork in the trail on the k.p. 74.1 (figure 48) in which one of the two paths (the one on the right) crosses a few meters of *Nardus* grassland.

Figure 48. Bifurcation of the path, with the one on the right crossing the Nardus grassland (k.p. 74.1).

Other the sections of the route to be highlighted in this aspect in the ESA 2 are those associated with the psychro-xerophilic high mountain grassland. It has been marked in the cartography as "sensitive to the trampling of fauna and flora of interest", the sections included around Cerro Claveles (k.p. 67.7 to 68.5), and crossed Puerto De los Neveros, from k.p. 69.1 to that same point (k.p. 72.8) on the return route, with the exception of small strips with consolidated path in the k.p. 69.7 or a scree with total absence of vegetation between the k.p. 69.5 and 69.7. In the rest of the stretch, species such as *Gentiana lutea* in the scree, *Erysimum humile subsp. penyalarensis* in the *Festuca curvifolia* grassland, and the rest of endemic species mentioned in the environmental inventory may suffer damage if the diversion of runners outside the marked paths is not avoided. In addition, in Cerro Claveles, it can be find one of the two specimen of *Senecio boissieri* cited in the Community of Madrid.

These grasslands with the presence of *Sedum sp*. is the potential habitat of *Parnassius apollo*, therefore, minimizing trampling of runners off of the marked trails will be essential to avoid a possible impact on this *Lepidoptera*. During the fieldwork the absence of path was confirmed in the Laguna de los Pájaros area, in a stretch of 240 meters between the k.p. 69.2 and 69.4 for the ascent journey, and the k.p. 72.6 and 72.8 for the descent. Here, the GTP route crosses *Cytisus oromediterraneus* scrubland. This is the potential habitat for orthoptera *Podisma carpetana subsp. carpetana*, in danger of extinction, reason why it is considered that the impact on it can be considerable.

4.2.4. Impacts on fauna by generation of noise

No specific sections of the route have been identified in which the race could generate a potential high impact on birdlife of the surrounding area. These data were provided by forest guards, who inform to the work team about the no existence of protected nest near the route of the race.

4.2.5. Impacts on flora and fauna by wading of streams, wetlands and peaty areas

- **Ecologically Sensitive Area (ESA) 1:**

The trails going across this ESA 1 do a couple of wading, in the Navacerrada River in the k.p. 5, and through a small water mass from a brook, on the k.p. 5.5. Apart from this, the presence of peat bogs and wet areas associated with the source of the Regajo del Cancho Negro brook should be mentioned, since it is very close to the race trail in the k.p. 7.5. This area can present the Habitats of Priority Interest 6230, with vegetation dominated by *Nardus stricta* associated with other silicolous species of interest.

Figure 49. Wade across Navacerrada River in k.p. 5.

- **Ecologically Sensitive Area (ESA) 2:**

The ESA 2 presents the most significant impact by trampling on flora and fauna in water courses and by potential degradation of riverbanks. It should be stand out the parts of the route going alongside streams formed by snow melting in one of the thalweg of the mountain range from Puerto de los Neveros to Peñalara (k.p. 64.6), as well as the wading of several streams and quagmires on the descent to San Ildefonso. In the first mentioned (k.p. 64.6), the route crosses a grassland with vegetation typical from areas with higher soil saturation as the *Nardus*, and vegetation from flooded peatbogs located in the bank of the stream, which can be potential habitat of flora and fauna of interest.

Figure 50. Path of the GTP running near vegetation typical from areas with higher soil saturation associated with a stream source in the k.p. 64.6.

Figure 51. Wading in Arroyo de los Carneros (k.p. 77) which must be signaled to cross through the bridge on the right in order to avoid the shortcut of the runners by the stones on the left.

Figure 52. Wading in the quagmires at k.p. 74.2 with associated Nardus grassland on the right bank.

5. Discussion

The identification of the impacts caused by the mountain race, carried out in the previous section, is a technical description of the potential impacts, but does not imply a quantification or assessment of the importance or gravity of them. Therefore, after this identification, it is important to analyse the magnitude of the potential impacts found, in order to assess their severity or reversibility.

In a normal impact assessment (EIA) situation, this assessment would be carried out by measuring and comparing the situation before and after the race. However, given that this study is carried out with the objective of identifying potential impacts and proposing the adoption of corrective measures, the following section will attempt to perform the prior assessment and characterization of those impacts. It has been taken into account previous environmental impact reports done on the area of Sierra de Guadarrama, taking then as a reference the reports made by Manuel Oñorbe (Oñorbe, 2015a, 2015b, 2015c).

In order to carry out the assessment in the most objective possible way, three researchers participated, who have discussed and agreed on the different categories of the assessment scale that have been applied to each type of impact. These categories and assessment scales are described below.

5.1. Impact Assessment

The main likely impacts found in this study due to the celebration of the Gran Trail de Peñalara race, and described in the previous section, are summarized in the table below. In that table a series of characteristics are analysed that help to make a qualitative assessment of these impacts. In creating this table and assessing the impacts, an Environmental Impact Assessment Report done by Stantec Consulting Ltd. (Stantec Consulting Ltd., 2015) on an open pit mine project was took as a reference. The characteristics to be evaluated and their scales and are the following:

- **Frequency**: the number of times that the environmental impact might occur along the race, and it assessment scale is:
    - Very rarely
    - Rarely
    - Occasionally
    - Frequently
    - Very frequently
- **Magnitude**: the gravity or amount of change that the impact can cause in the environment, defined as:
    - Low
    - Medium
    - High
- **Resilience**: the capacity of the natural environment to respond to the disturbance by resisting damage and recovering quickly, with or without corrective measures. It follows the next scale:
    - Not significant
    - Compatible: Immediate recovery after the conclusion of activity, without preventive or corrective measures

- Moderate: The recovery does not require intensive corrective measures, although it does take some time
- Severe: The recovery of original environmental conditions requires preventive or corrective measures, and a long period of time
- Critical: Unacceptable, permanent quality loss of environmental conditions, without possible recovery

POSSIBLE IMPACT		FREQUENCY	MAGNITUDE	RESILIENCE
SOIL	Erosion	Occasionally	Medium	Moderate
	Diffuse trail networks	Frequently	High	Severe
VEGETATION	Degradation of vegetation by trampling	Occasionally	Medium	Moderate
	Damage to singular vegetation ("of interest")	Occasionally	High	Critical
FAUNA	Damaged to small species by trampling	Rarely	High	Moderate
	Disturbance to birdlife by noise	Very rarely	High	Compatible
	Indirect impact on fauna by damage to their habitats	Occasionally	Medium	Moderate
	Degradation of Habitats of Community Interest classified as Priority Habitat	Occasionally	High	Moderate
WATER (STREAM, RIVERS, WETLANDS)	Fords crossed by the route	Frequently	Medium	Severe
	Degradation of stream beds and wetlands	Occasionally	Medium	Severe
OTHER IMPACTS	Waste generation	Rarely	Low	Compatible
	Forgetting arrows or other signpost elements in the field	Occasionally	Low	Compatible

Table 1. Assessment of potential impacts.

As it can be observed in the table, one of the impacts with greater probability of occurrence along the race is the appearance of diffuse trail networks, characterized by high magnitude, since it can trigger a deterioration of the surrounding vegetation by trampling. That is why it requires a longer recovery time after the implementation of corrective measures.

This type of impact leads, as it has been mentioned, to a damage of vegetation, in particular to a possible damage to important species listed in the Regional Catalogue of Endangered Species (CREAM). That is why this impact has been classified as "Critical", since the possible places where it may appear are the ones in need of better management of the preventive measures, given that its recovery is harder.

In most of the studies done about the effects of hikers and runners on the environment of protected areas, it has been proven that those two impacts mentioned above are the most common and with more likelihood to be found. In the study made by Farrell & Marion (2001), it was found that grassland areas, with medium-use of trail, had a greater number of diffuse trail networks, despite the greater trampling resistance and resilience of grassland vegetation, because trees and other natural barriers in forested environments tended to confine visitors to trails, whereas open grassland environments permit easier and more inviting off-trail travel. These results can be related with the ones found in the current report, as the most sensitive areas and those more likely to suffer widening of trails or bifurcations are the one in high mountain passes, with grassy vegetation. However, Weaver and Dale found different results in their study made in Rocky Mountains in 1978, as the percentage of bare ground increased in dwarf shrub more rapidly than in grassy vegetation (Weaver & Dale, Trampling effects of hikers, motorcycles and horses in meadows and forest, 1978), and, in contrast to Bayfield (1971) and Weaver & Dale (1974), it was not confirmed that trails were wider in meadows than in forest.

Another important factor that influences the magnitude of erosion and degradation of trails and surrounding vegetation is the slope. Sanjay Nepal shows in his study that trail grade is one of the most important factors associated with severe trail degradation (Nepal, 2003), being thus consistent with other studies, as for example Farrell & Marion (2001), who shown that trail grade was an important factor influencing the amount of erosion incision.

The other two potential impact that are considered as more important, are those related to water environments. This is due to the amount of streams crossed by the race along its entire route. These environments require a longer recovery time to reach their original state after suffering damage, because these damages can be very diverse, from damage by trampling to the aquatic fauna and flora living there, to damage to the water quality by pollution. For example, Hadwen & Bunn (2004) found that increasing numbers of visitations to dune lakes on Australia's Fraser Island was positively correlated with a shift in the aquatic food web toward a stronger reliance on algal resources, the production of which is stimulated by nutrient inputs from visitors. In the case of the current report, these results are hard to happen, as the influence of people on water areas are scarce on the context to which Hadwen and Bunn are referred.

The other impacts reflected on the table are of lesser repercussion, since with the proper preventive and corrective measures they can be avoided and controlled, and, in addition, there is less probability that they occur throughout the race.

One issue could be mention with regard to the magnitude of impacts would be the number of runners participating in the race. This matter may lead one to think that the most number of runner the most impact severity. Nevertheless, this fact has not been prove and it is difficult to do it, as existing research has provided mixed results (Farrell & Marion, 2001). Some researches, for example, have shown that the majority of impact occurs with trail development and low levels of use, reducing the effectiveness of use limitation as a management tool (Hamrnitt & Cole, 1998; Leung & Marion, 2000). Therefore, it cannot be demonstrated that number of runners can influence the severity or gravity of the potential impacts found.

However, and as it has already mentioned, following a series of preventive and corrective measures, the likelihood of all these negative effects occurring on the environment where the race takes place can be avoided or minimized.

5.2. Preventive and Corrective Measures

One of the main objectives of this study is to identify potential impacts of the Gran Trail Peñalara mountain race to propose measures to minimize or correct these impacts. As it has been proved, and as shown in the table, most of the identified impacts are moderate or compatible in terms of resilience, and they can be corrected with small actions or behaviour codes for runners and spectators. This section describes in detail the suggested preventive or corrective measures to be taken by the organizers of the race to ensure that the sport activity will cause reversible and controlled impacts. These measures are classified in the same "Ecologically Sensitive Areas" defined in the last section "Results".

5.2.1. Risk of soil erosion and soil compaction

- **Ecologically Sensitive Area 1:**

As mitigating measures of the degradation of edaphic cover in some stretches in this part of the race, the following corrections will be applied:

- Intensive signposting of the approved trails in these areas, so that the runners follow a single path in the diffuse trail networks.
- In the cases of the shortcut of the 150 meters zig zag trail (k.p. 12.7) and of the PR-M 26 (k.p. 110.7) it must be avoided to take these short-cuts and the forest path must be correctly marked.
- It must be mandatory to follow the approved path PR 26 and PR 16, instead of marking the route through the scarcely consolidated shortcut. This is indicated in figure 53.

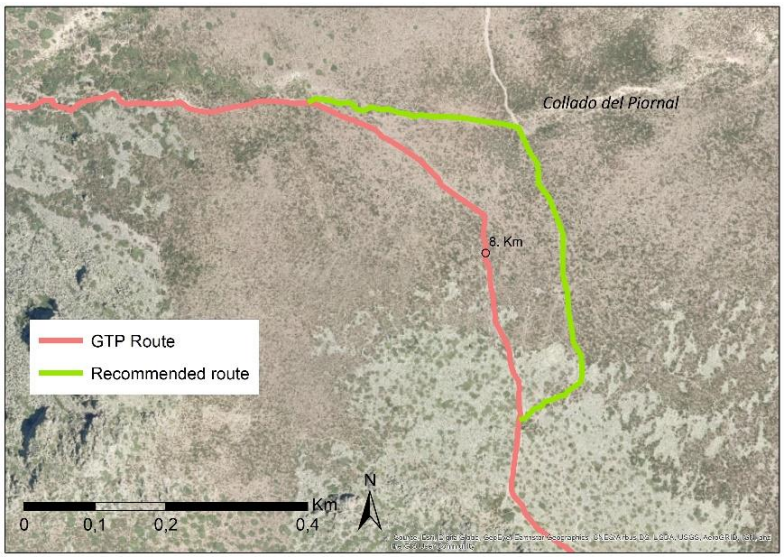

Figure 53. GTP route correction in the surroundings of Collado del Piornal.

➢ **Ecologically Sensitive Area 2:**

The corrective measures to carry on by the organizer of the GTP race in order to avoid the impact on the soils structure in this ESA will be:

- Intensive signposting of all the marked areas in the cartography, in order to avoid the diversion of runners by multiple paths and ramifications that increase the erosion and compaction of the soil, or the formation of new paths, as well as the increase of the degradation state which already present some sections.
- In Puerto de los Neveros it is recommended to signpost the route along the path that goes to the left of the arrows (for the outward journey) and along the path that passes behind these arrows (for the return) in order to avoid the shortcut by the pastureland.

5.2.2. Waste generation

In order to mitigate the negative impact on the environment caused by waste generation, and taking into account the corrective measures proposed in the Guide to good practices for holding mountain races in protected natural areas (EUROPARC-España, 2016), the following measures must be taken:

- Containers for waste separation will be placed in the aid stations as well as in the start and finish area of the race, in Navacerrada.
- At the aid stations, food and drink should not be in bottles, tins or other containers, and the fruit should be already peeled.
- Any bottle, tin or other kind of container owned by runners, must have his or her number indicated on it, and, in the case of liquids, the organization may refill the canteen or drinking vessel ported by runners.

- The organization of the race will have staff dedicated to the cleaning of waste in the trail after the race. They will also be responsible for the removal of the arrows and signalling elements.

Figure 54. Example of aid station with organization staff refilling the containers ported by runners.

Beside this, according to the general recommendations for good environmental practices in mountain races (EUROPARC-España, 2016), all aid stations should be located at least on the forest path, if not possible on paved sections or in urban centres. In accordance with this precept, two measures are established for the GTP (see attached cartography):

- To locate the Puerto Del Reventón Aid Station a little earlier in the route, on the forest path that ends around the k.p. 62.5.
- To locate the Raso Del Pino Aid Station a little further along the route, at the level of the esplanade in the forest path at k.p. 77.2, after crossing the Arroyo de los Carneros stream.

5.2.3. Damage to flora and fauna by trampling of runners off of the trails

➢ **Ecologically Sensitive Area 1:**

The corrective measures of potential impacts caused by trampling on this Environmental Sensitivity Zone will be the following:

- Avoid or reduce the impact to the minimum, and as it has been proposed in the corrective measures to prevent erosion and compaction, the approved trails PR 26 and PR 16 will be followed, avoiding thus taking the short-cut through the grassland.
- There will be an intensive signposting in this section of the route to avoid trampling of other species of interest such as *Gentiana lutea*, and to avoid disturbances to the nests and avifauna typical of peaks and high areas mentioned in the inventory.

- Intensive signposting should be placed in the path by peat bogs and *Nardus* grasslands in k.p. 7.5, as well as preventing the spectators from standing in the indicated area by placing a warning seal or direct surveillance by the organization staff (figure 55).

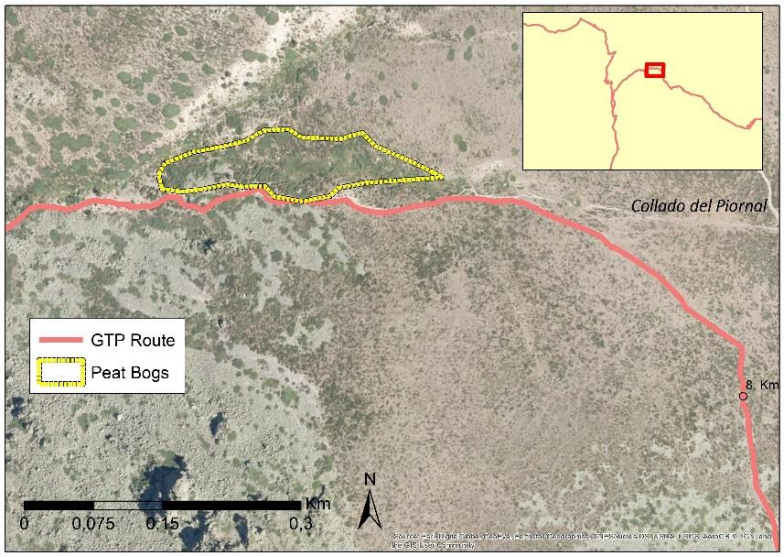

Figure 55. Peat bogs in k.p. 7.5 in relation to the race route.

➢ **Ecologically Sensitive Area 2:**

The corrective measures that must be adopted by the organization to safeguard the ecological wealth of ESA 2 will be:

- In the small stretches of *Nardus* grassland an intensive signposting should be carried out in the drier areas, as well as marking by the left path in the section that crosses a small *Nardus* grassland in the k.p. 74.1.
- Intensive signposting of the rest of the areas with potential impact due to trampling of runners (psychro-xerophilic grassland, *Festuca curvifolia* grassland and scree), adjusting thus to the approved and marked trails in order to avoid trampling of the indicated sensitive species.
- Design a change of the route in the indicated section of Laguna de los Pájaros area in order to avoid cross country running and provoke the mentioned impacts (figure 56). The race will be diverted to the approved PR 15 path that goes towards the lagoon, and the public will be forbidden to locate in the peat bogs near the route associated with the water masses. Intensive signposting will also be necessary here since the new route would cross *Nardus* grassland.

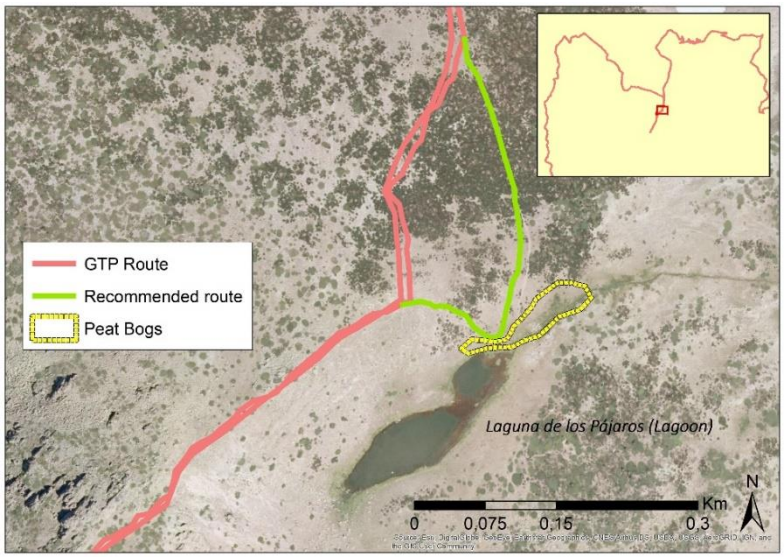

Figure 56. Correction of the original route near to Laguna de los Pájaros.

5.2.4. Impacts on fauna by generation of noise

As long as the following measures are respected during the race, there would be no significant effects caused by noise on birdlife of the surrounding:

- Public address systems will not be applied outside the urban centres, and the volume will not exceed the level that could be listened outside those areas.
- Pyrotechnics or similar will be forbidden both inside and outside the urban centres.
- The organization will indicate in its environmental information to runners and the public that no excessive or above normal noise levels for the natural environment must be generated, including the possibility of penalising those who do not obey this instruction.

In addition, for this last measure, the organization´s staff will be responsible of monitoring the compliance of these measures in the following sections of the route:

- Surroundings of La Maliciosa summit and Sierra de los Porrones.
- Forest path through pine forest between the k.p. 13 and 17.
- Pedriza mountain range between the k.p. 18 and 21.
- Surroundings of the Peñalara Massif (Peñalara summit and Risco de los Pájaros)
- San Ildefonso pine forest, between the k.p. 74.5 and 77, and k.p. 77.3 and 79.
- Pine forest in La Barranca: Stretch of trail between the k.p. 108.2 and 109.6.

5.2.5. Impacts on flora and fauna by wading of streams, wetlands and peaty areas

➢ **Ecologically Sensitive Area 1:**

The corrective measures to be adopted by the organization in order to avoid these kind of impacts will be:

- Ensure as far as possible that the runners do not trampling through water areas or water saturated areas, either by appropriate signposting to avoid them, or by placing stones or thick planks that facilitate the passage through them.
- The peat land areas, as indicated in the paragraph of "Damage to flora and fauna by trampling of runners off of the trails", must be intensely marked in order to avoid trampling of runners off of the trail. In addition, masses of public in this areas will be avoided.

➢ **Ecologically Sensitive Area 2:**

The corrective measures to be developed in this part of the race in regard to prevent possible negative effects are the following:

- Appropriate and intensive signposting of trails, to mark those stream ford through drier areas in order to avoid trampling of saturated surfaces, waterlogged or the water channels itself.
- Avoid crowds at these points by signaling of peat bogs and surveillance during the race. In particular, this measure will be applied to the peat bogs mentioned at the source of the stream of k.p. 64.6.
- For the wading at the pine forest in the descent stretch to San Ildefonso, an adequate signposting should be done in order to avoid negative impact on possible species of amphibians, reptiles and invertebrates living there, as well as signaling the ford of Arroyo de los Carneros stream (k.p. 77) and Arroyo del Morete stream (k.p. 78.8) by the existing bridges. The bridge in Arroyo del Morete stream may require some type of restoration to ensure the safety of runners.

5.2.6. Environmental Education

Moreover, in addition to these more technical preventive measures, it is worth emphasized the great importance of social measures, as it is the environmental education. This idea is based on the suggestions made by Benayas, Faucha, & Oñorbe, in 2017. It is advisable, therefore, to create a project parallel to this race and to other mountain races in which the environmental education of the participants and spectators is promoted. In this project must be carried out consciousness-raising and awareness-raising activities for runners, in order to get them to be concerned about the natural environment where they are and the sustainability of it. In this way, it is possible to ensure a better achievement of the objectives foreseen by the previous technical preventive and corrective measures.

The activities that these education, awareness-raising and consciousness-raising projects should carry out are the following:

- Meetings previous to the celebration of the race in which runners are informed about the basic rules of respect for the natural environment and the current regulation of the National Park.

- A short online course that runners have to pass prior registration in the race, in which they are shown how to behave in the natural environment during the race to cause the least possible impact on the environment, as well as teach them the most important natural values of the National Park.
- Environmental training for volunteers of the race and organization staff.
- Information to the public in the urban areas crossed by the race, about good environmental practices.
- Ensure accessibility through the GTP web page to information on the natural environment where the race is carried out and the possible impacts that runners or spectators could generate on the nature.

It should be noted the great importance on monitoring the execution of those corrective and preventive measures, as analysis of data from different monitoring cycles could reveal trends in trail conditions and evaluate the effectiveness of implemented management actions (Leung & Marion, 1999).

6. Conclusion

According to the obtained results, it can be concluded that this mountain race does not have an irreversible impact on the environment, and that its celebration is compatible with the natural values of the Sierra de Guadarrama National Park, as long as the preventive measures proposed in this report are met. It must be emphasized the great importance of the latest, since the application of these measures can highly reduce the likelihood of a negative effect on the environment.

Within the preventive and corrective measures, explained in the previous section "Discussion", it must be given significant importance to the social measures of environmental education, since it is the first step to carry out good environmental practices during the celebration of the race. On the other hand, among the technical measures, that make a great contribution in avoiding potential impacts, are the intensive signposting of trails and water courses, the location of aid station in urban areas or forest paths, avoid producing loud noises, and monitoring compliance with all these measures.

It is now when this type of Environmental Impact Assessment Reports is becoming more important, since with the implementation of the new Use and Management Master Plan (PRUG), many activities and projects carried out in the National Park will need an Environmental Impact Assessment to get authorization. This is due to the new measures that will be taken with this Master Plan, and with the idea of achieving higher protection state of this protected area. In this way, the potential impacts and corrective measures of the activities held within this area can be determined.

But not only the activities whose EIA is mandatory for authorization are doing so, but there is a growing trend of activities with no requirement of EIA that are doing the study in order to demonstrate their involvement with the sustainability objectives of National Park´ Master Plan, and proving that their activities have not significant negative effects on the environment.

Lastly, it is necessary to mention the lack of studies related to other types of impacts that mountain races can cause in the environment. Among them, the two most important that should be highlighted are the impacts to Nocturnal wildlife in races with night itinerary, and the impacts on the animal behaviour and the influence that races may have on their reproductive cycles. So far, few or no studies can be found on these issues, since these impacts are much more difficult to assess than those addressed in this EIAR. Therefore, it must be emphasise the importance of EIA in analysing impacts of soil erosion, degradation to vegetation and water environments, as well as impacts on the behaviour of nocturnal and diurnal fauna, in order to have a full report on all the possible impacts of mountain races and being able to carry out management plans to avoid them.

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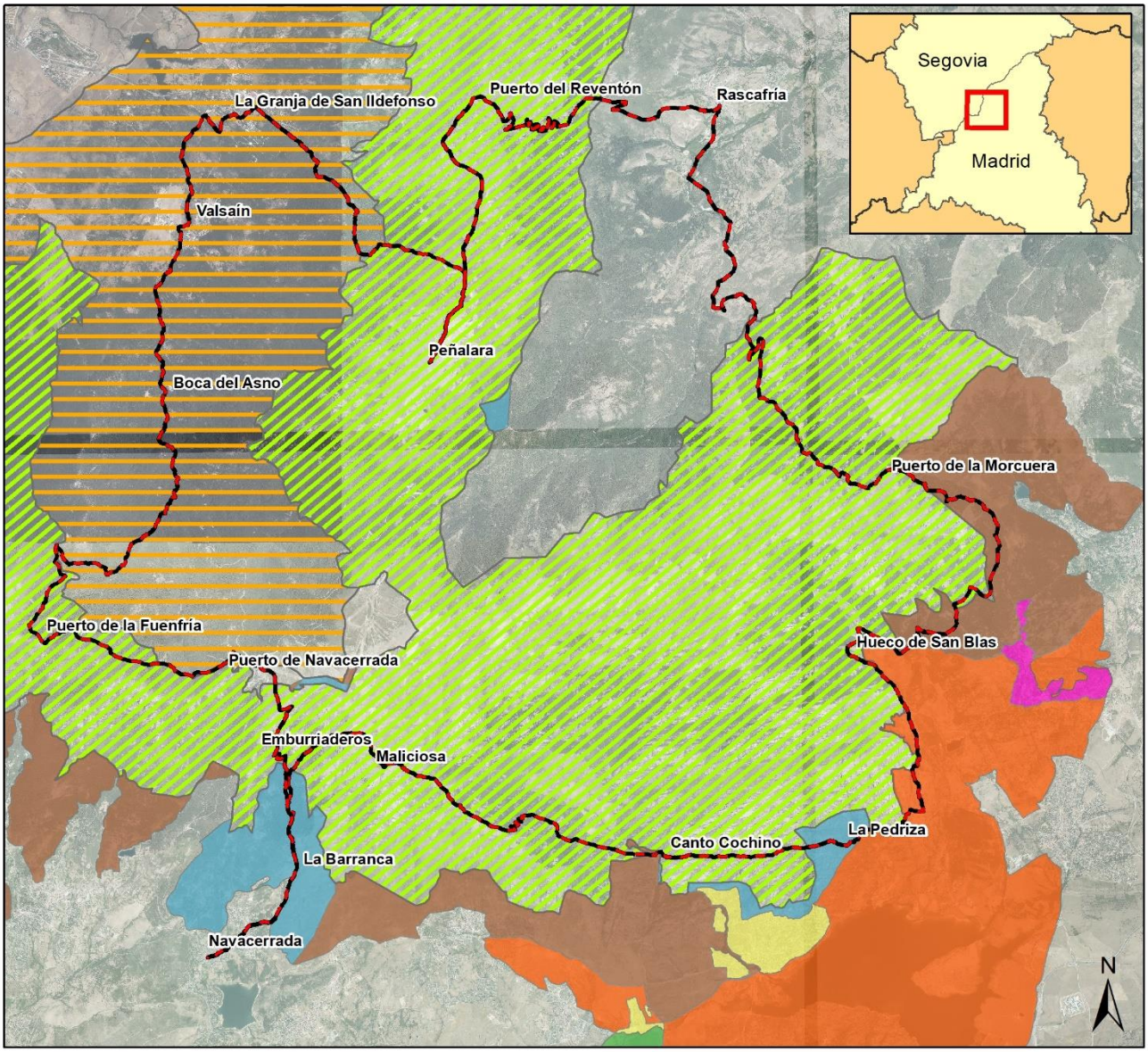
8. Appendix

8.1. Appendix 1: Cartography of Protection Figures

Map of Protected Areas:
Sierra Norte de Guadarrama (Segovia and Ávila) Natural Park
Guadarrama Nacional Park
Cuenca Alta del Manzanares Regional Park



GTP route

0 1,5 3 6 9 12 Km

Zoning of Cuenca Alta del Manzanares Regional Park

- A1: Comprehensive Natural Reserve
- A2: Educational Natural Reserve.
- B1: Agriculture and Livestock Protector Regional Park
- B2: Agriculture and Livestock Producer Regional Park
- B3: Agricultural and Livestock Regional Park to be regenerated.
- P: Areas to be ordered by Urban Planning.
- T: Transition Areas

Protected Areas

- Sierra Norte de Guadarrama Natural Park
- Sierra de Guadarrama Nacional Park

Peñalara
Real Sociedad Española de Alpinismo

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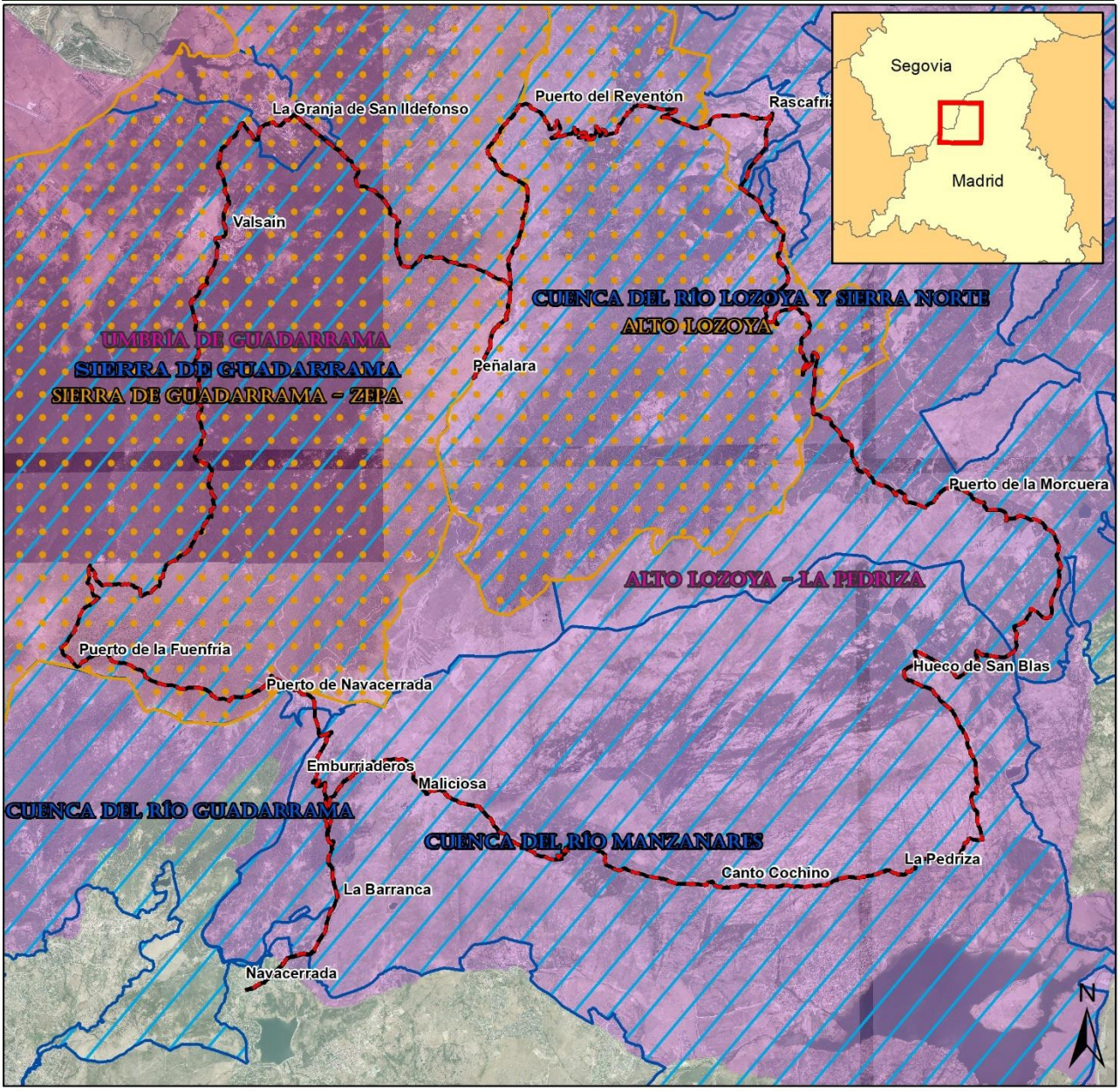
Map of Natura 2000 and Important Bird and Biodiversity Areas (IBA)



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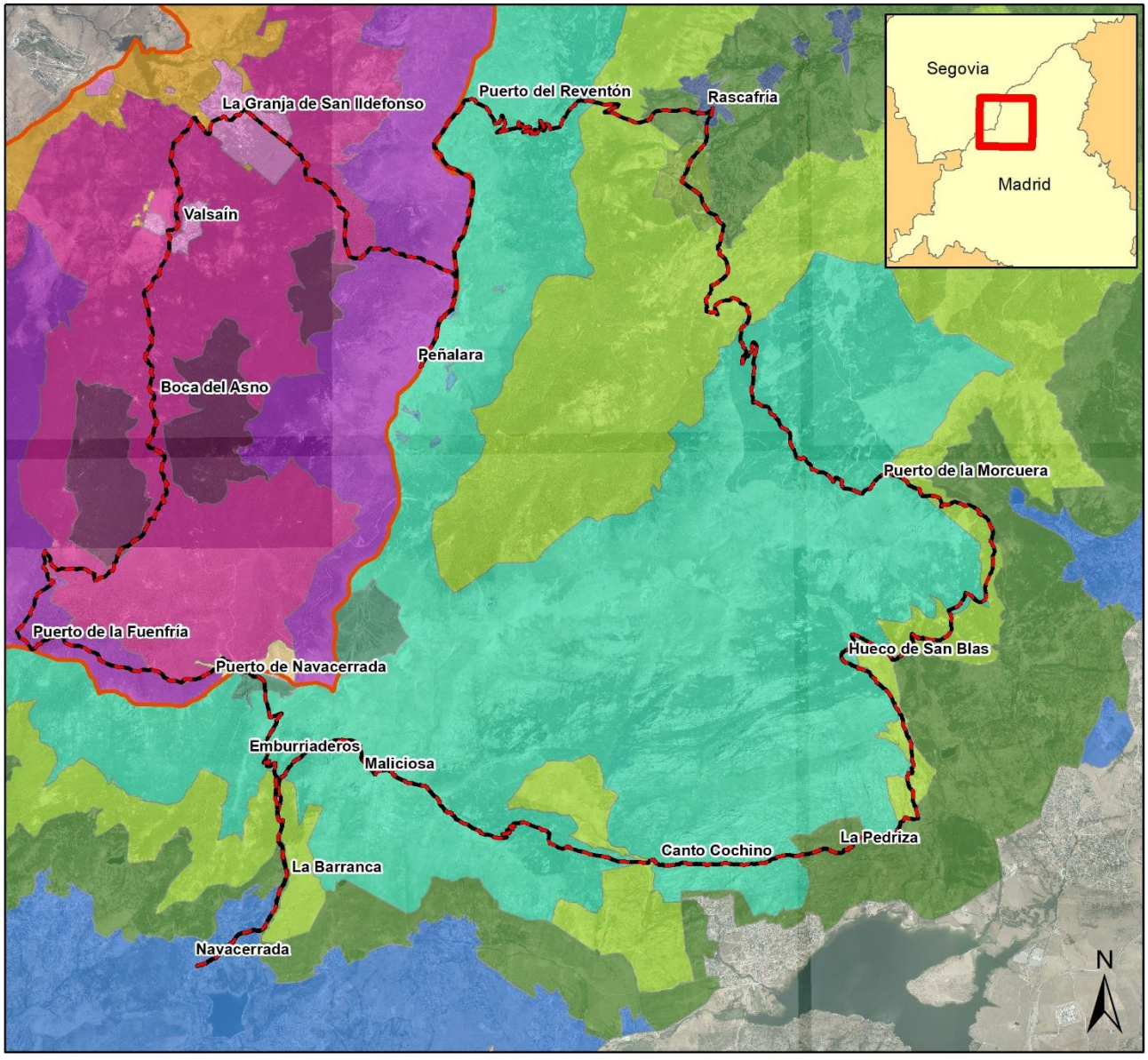
Map of Natural Resources Management Plan (PORN) of Sierra de Guadarrama National Park, in Castilla and León and Community of Madrid



0 1,5 3 6 9 12 Km

GTP route

NRMP Castilla and León

- Undeclared Ordered Zone
- Special Management Zone
- Compatible Usage type A Zone
- Compatible Usage type B Zone
- General Usage Area
- Limited Common Usage Zone
- Limited Summits Usage Zone
- Limited Usage and Especial Interest Zone

NRMP Community of Madrid

- Special Zone
- Natural Resources Ordained Usage Zone
- Traditional Settlements Zone
- Preservation and Traditional Uses Maintenance Zone
- Maximum Protection Zone
- Reserve Zone
- Transition zone
- Urban Planning Zone

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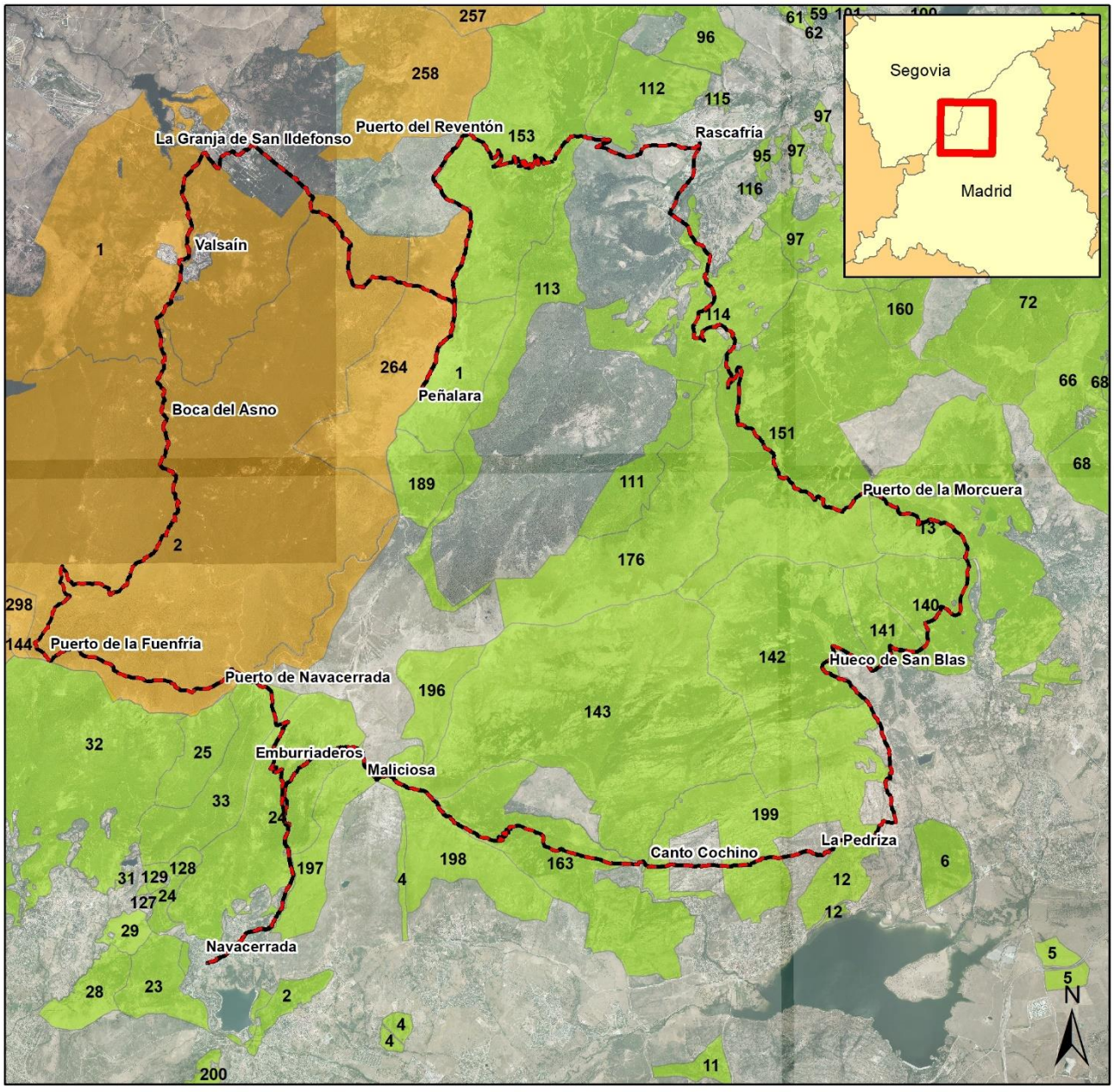
Map Woodlands of Public Benefit of Segovia and Madrid



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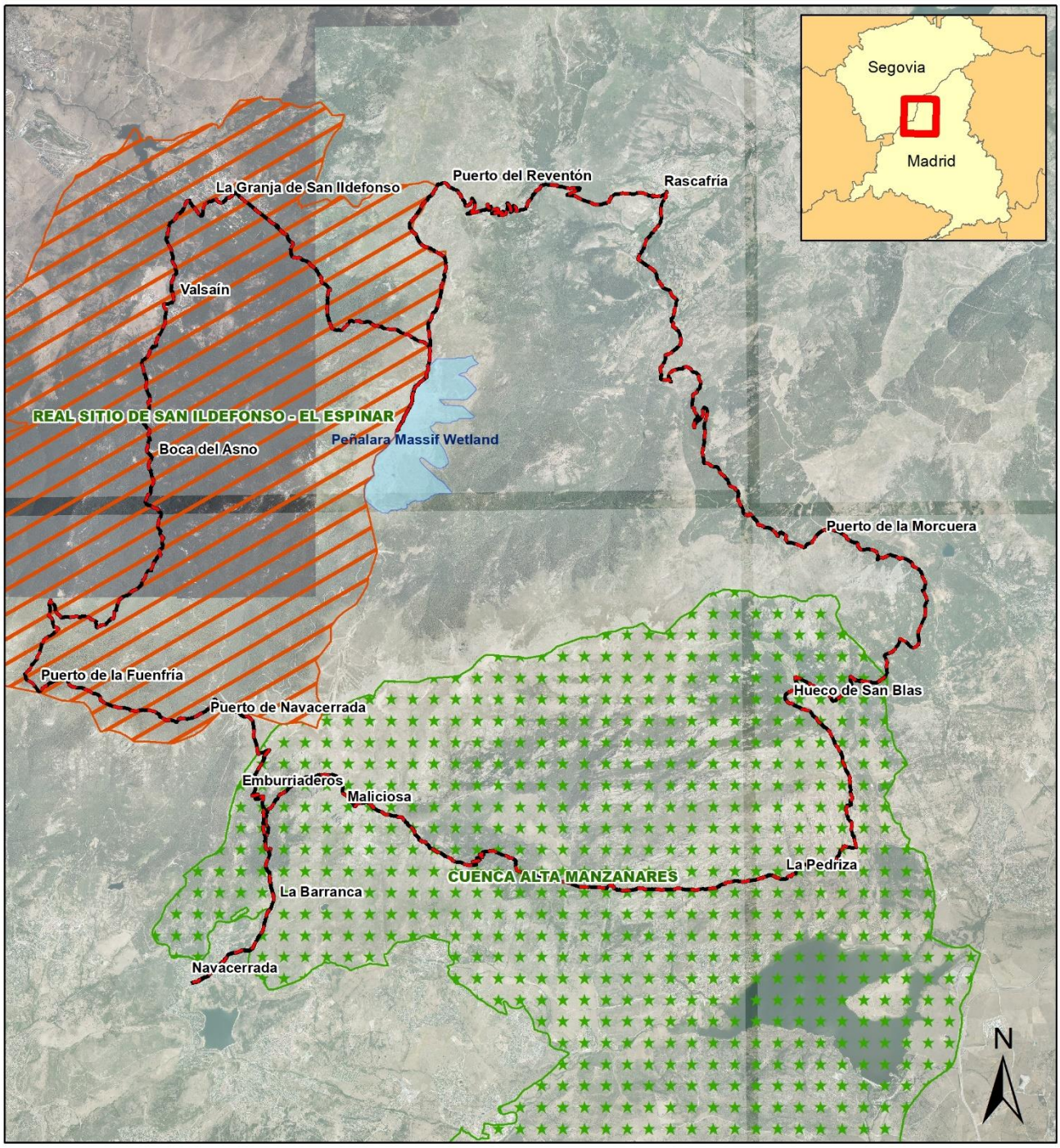
Map of Biosphere Reserves and Ramsar Sites



GTP route

Ramsar Sites - Wetlands of Macizo de Peñalara

Biosphere Reserves

CUENCA ALTA MANZANARES

REAL SITIO DE SAN ILDEFONSO - EL ESPINAR

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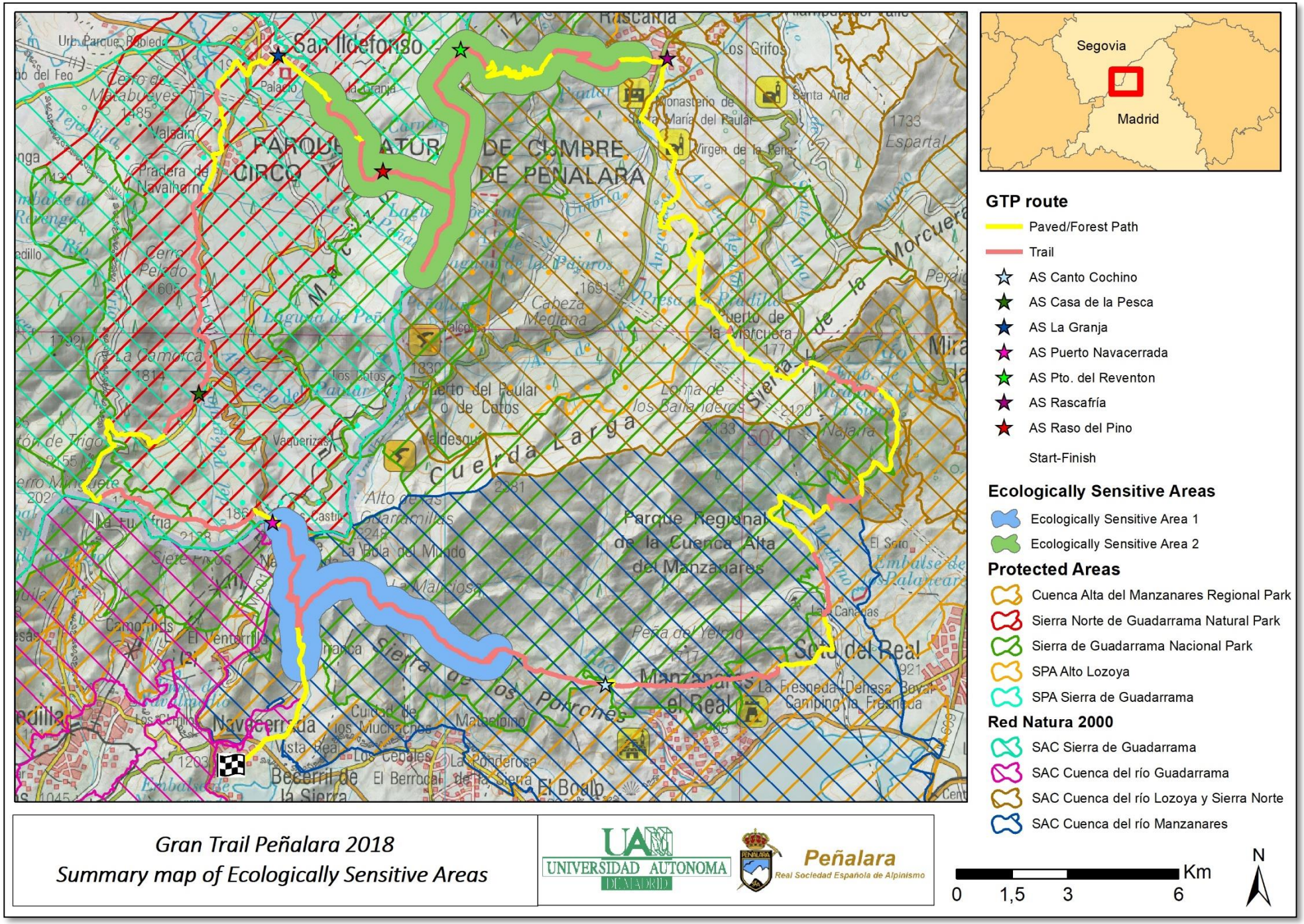
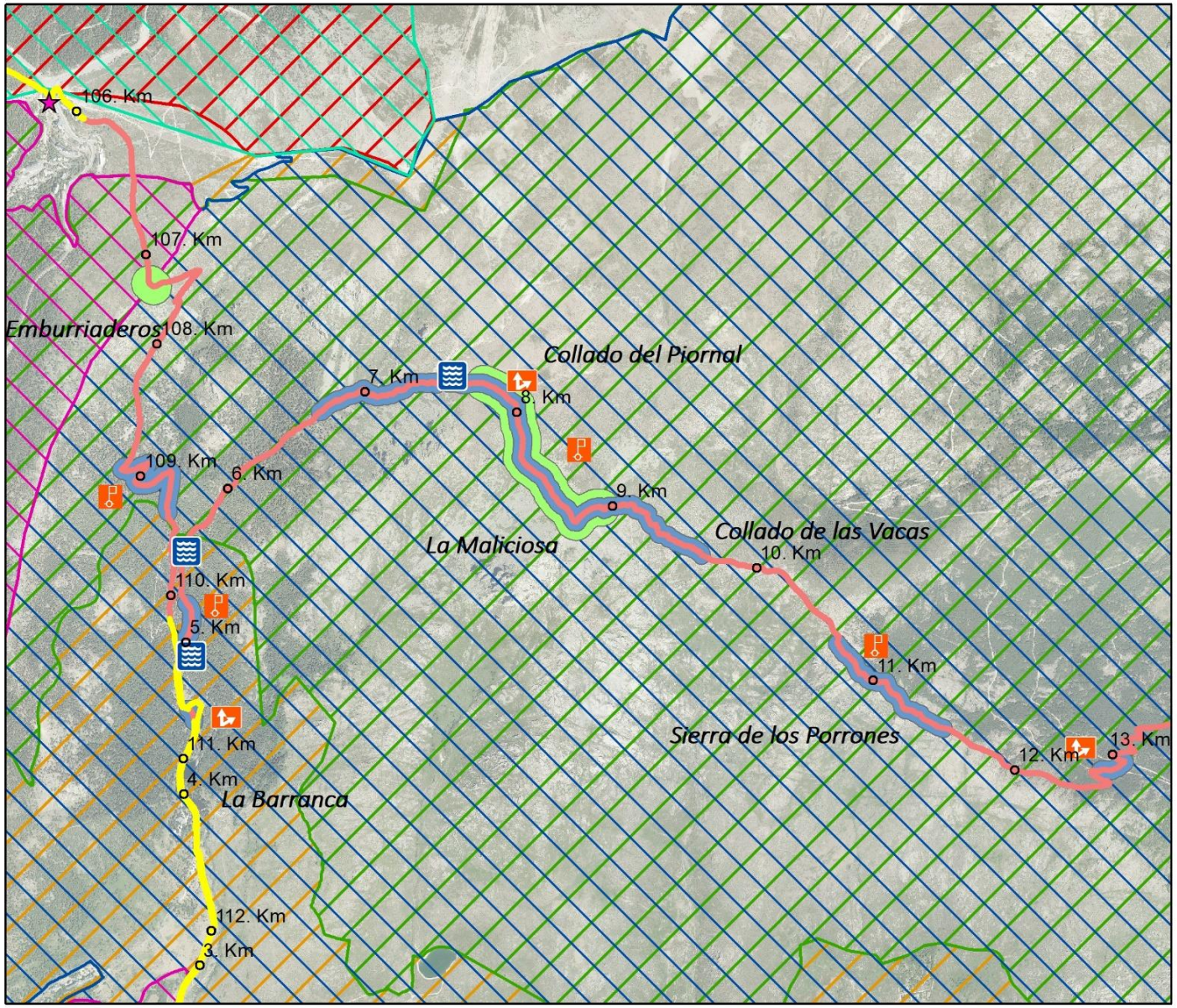
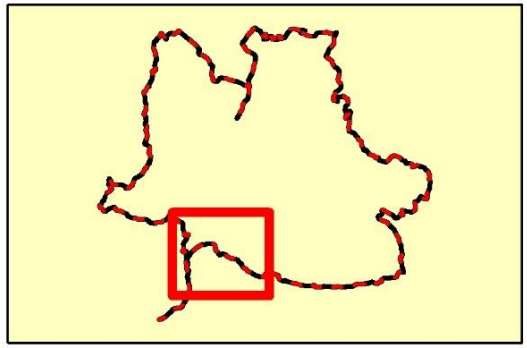
8.2. Appendix 2: Cartography of Potential Impacts and Corrective Measures


Segovia
Madrid
GTP route
Paved/Forest Path
Trail
AS Canto Cochino
AS Casa de la Pesca
AS La Granja
AS Puerto Navacerrada
AS Pto. del Reventon
AS Rascafría
AS Raso del Pino
Start-Finish
Ecologically Sensitive Areas
Ecologically Sensitive Area 1
Ecologically Sensitive Area 2
Protected Areas
Cuenca Alta del Manzanares Regional Park
Sierra Norte de Guadarrama Natural Park
Sierra de Guadarrama Nacional Park
SPA Alto Lozoya
SPA Sierra de Guadarrama
Red Natura 2000
SAC Sierra de Guadarrama
SAC Cuenca del río Guadarrama
SAC Cuenca del río Lozoya y Sierra Norte
SAC Cuenca del río Manzanares
Km
0
1,5
3
6
N
Gran Trail Peñalara 2018
Summary map of Ecologically Sensitive Areas
UNIVERSIDAD AUTONOMA DE MADRID
Peñalara
Real Sociedad Española de Alpinismo





GTP route

- Paved/Forest Path
- Trail
- AS Puerto de Navacerrada

Potential impacts and corrective measures

- Intensive beaconing
- Correction of the route
- Ford
- Diffuse trail networks and erosion risk
- Trampling of fauna and flora

Protected Areas

- Cuenca Alta del Manzanares Regional Park
- Sierra Norte de Guadarrama Natural Park
- Sierra de Guadarrama Nacional Park

Natura 2000

- SAC Sierra de Guadarrama
- SAC Cuenca del río Guadarrama
- SAC Cuenca del río Lozoya y Sierra Norte
- SAC Cuenca del río Manzanares

N

0 5 10 20 Km

Gran Trail Peñalara 2018

Map of potential impacts and corrective measures

Ecologically Sensitive Area 1

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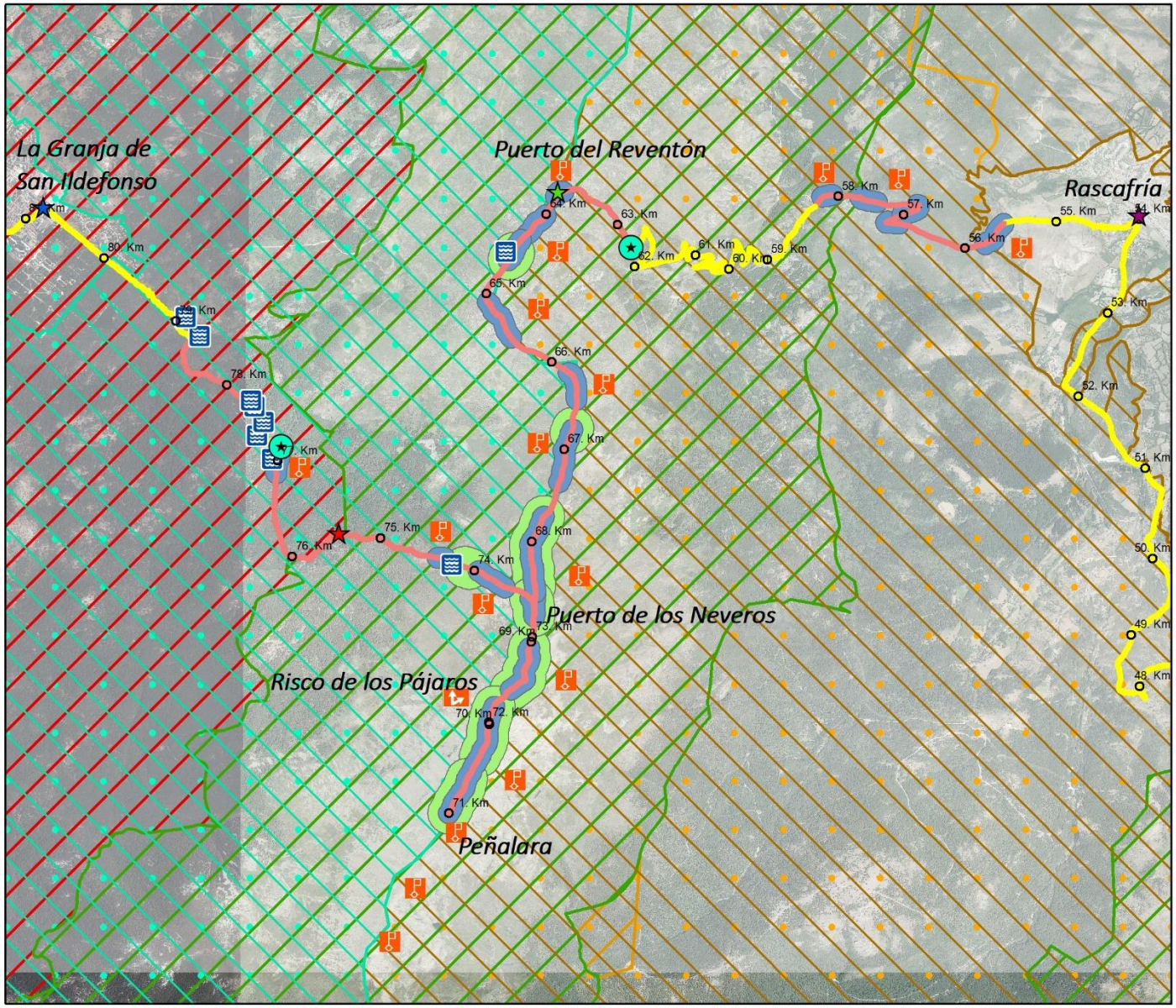
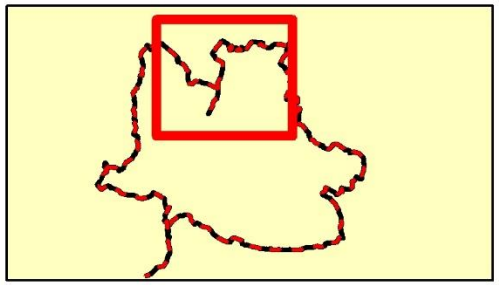
Peñalara
Real Sociedad Española de Alpinismo





GTP route

- Paved/Forest Path
- Trail
- AS La Granja
- AS Pto. del Reventón
- AS Rascafría
- AS Raso del Pino
- Alternative AS

Potential impacts and corrective measures

- Intensive beaconing
- Correction of the route
- Ford
- Diffuse trail networks and erosion risk
- Trampling of fauna and flora

Protected Areas

- Cuenca Alta del Manzanares Regional Park
- Sierra Norte de Guadarrama Natural Park
- Sierra de Guadarrama Nacional Park

Natura 2000

- SAC Sierra de Guadarrama
- SAC Cuenca del río Guadarrama
- SAC Cuenca del río Lozoya y Sierra Norte
- SAC Cuenca del río Manzanares
- SPA Alto Lozoya
- SPA Sierra de Guadarrama

0 0,75 1,5 3 Km

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Gran Trail Peñalara 2018
Map of potential impacts and corrective measures
Ecologically Sensitive Area 2

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