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Guidelines to prevent soil contamination in the ELV sector (End-of-Life Vehicles)

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Glossary

ARC	*Agència de Residus de Catalunya* - Waste Agency of Catalonia
APC	*Actividades Potencialmente Contaminantes del suelo* - Potentially Soil Polluting Activities
ATF	Authorized Treatment Facility
BOE	Boletín Oficial del Estado - State Official Journal
CER	*Catálogo Europeo de Residuos* - European Waste Catalogue
CNAE	*Código Nacional de Actividades Económicas* - National Code of Economic Activities
DGT	*Dirección General de Tráfico* - National Department of Traffic
DOGC	*Diari Oficial de la Generalitat de Catalunya* - Official Journal of the Generality of Catalonia
EMAS	EU Eco-Management and Audit Scheme
EC	European Community
ELV	End-of-Life Vehicles
EU	European Union
GIS	Geographic Information Systems
HSE	Health, Safety & Environment
IGME	*Instituto Geológico Minero de España* - Geological and Mining Institute of Spain
ISO	International Organization for Standardization
IPS	*Informe Preeliminar de Situación* - Preliminary Situation Report
MAPAMA	*Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente* - Spanish Ministry of Agriculture Fisheries, Food and Environment
NFU	*Neumáticos Fuera de Uso* - Out of Use Tires
PEIN	*Plan de espacios de interés natural* - Plan of Spaces of Natural Interest
PEMAR	*Plan Estatal Marco de Gestión de Residuos* - State Plan for Waste Management
RD	Royal Decree
WEEE	Waste Electrical and Electronic Equipment
WWTP	Wastewater Treatment Plant

Abstract

When a vehicle reaches the end of its useful life it is considered hazardous waste and therefore must be managed in an Authorized Treatment Facility (ATF). These vehicles include large quantities of hazardous substances which could affect the quality of the subsoil when they are not treated appropriately.

Furthermore, soil is considered as one of the most sensitive and vulnerable receptor of contamination. For this reason this project is based on the prevention of soil contamination in the particular case of End-of Life Vehicles (ELV) management.

The main objective of this paper is to detect the most critical operations during ELV treatment and propose preventive measures to avoid subsoil contamination. In order to achieve this, a checklist has been developed to evaluate this type of facilities and fieldwork has been done in collaboration with the department of Soil Contamination Management in the Waste Agency of Catalonia (ARC). Moreover, this research has created and developed a risk assessment, which combines together damage and vulnerability.

The results obtained show critical operations for subsoil quality: decontamination, waste storage and compaction zones. Comparing the results obtained with the experimental work done, the results give a reliable methodology to evaluate the environmental risk of a facility in terms of subsoil hazard. The objective of this part in the near future is to implement this tool in the administration assess of Potentially Soil Polluting Activities (APC).

Finally, a series of improvements in the different phases of design, operation and dismantling in ATF are proposed. This will enable to make this activity more sustainable and respectful with the environment.

Keywords: End-of-life Vehicles, Authorized Treatment Centre, subsoil, prevention, contamination.

1. Introduction

One of the most important problems of our current society is the generation of waste and its management. In recent years, many innovations have been implemented in order to reduce risk and pollution involved with waste management. But stricter regulations and legislations still need to be put in place in order to limit the risk of soil, water and atmosphere contamination throughout Europe. These guidelines should combine industrial benefits with the protection of the environment and responsible consumption of raw materials.

In the automotive industry, when a vehicle reaches the end of its useful life it is considered an hazardous waste and therefore must be sent to an Authorized Treatment Facilities (ATF). These facilities have the responsibility to manage End-of-Life Vehicles (ELV) in an appropriate and sustainable way. This process involves many critical steps, and managing the End-of-Life vehicles in an ATF could easily lead to soil or groundwater contamination.

In 2000, the growing problem of waste generated by scrapping vehicles caused the European Union to adopt the *Directive 2000/53/EC* on end-of-life vehicles. The aim of the "*ELV Directive*" was to reduce the quantity and danger of waste created by those vehicles. In addition, the new guideline aimed to improve the management of waste generated and helped with the harmonization and regulation of the sector. Eventually, it permitted an improvement in the dismantling and recycling of ELV making the whole process more environmentally friendly.

Transposed to Spanish law by *Royal Decree 1383/2002*, all facilities part of the treatment chain of ELV had to adopt and follow the requirements set by the Euopean Union. This was indeed the first turning point towards a *greener* and more respectful waste management.

In addition, according to the waste treatment hierarchy adopted in the Spanish *Law 22/2011*, of contaminated waste and soils, priority was given to prevention, followed by preparation for reuse, recycling, recovery and finally disposal in landfill. This way, ELV decontamination and dismantling take up as an important role in the life cycle of vehicles. Because each vehicle has a large amount of materials and components that can be reused or recycled.

Based on this legislation, one of the objectives proposed in the current legal framework of end-of-life vehicle management, *RD 20/2017*, is to increase the percentage of parts and components reused over the total weight of vehicles treated annually. Furthermore, the legislation also encourages the percentages of recovery of vehicle to be maintained. It is therefore the reason for the increased number of this type of facilities in recent years.

According to the 2017 statistical data there are 158 ATF in Catalonia (Figure 1), which represents 12% of the total number in Spain (ARC, 2017). This research gains justification while looking at the overall old age of vehicles, the renewal plans, the new classification of vehicles by the National Department of Traffic (DGT) and the philosophy of Circular Economy.

Figure 1. ATF located in Catalonia. Source: ARC (2017)

Considering all the above aspects, the present prevention guide for soil contamination is developed for the ELV sector. The main objective is evaluating and assessing the different zones, processes and operations that may have an impact on the subsoil.

2. Objectives

On the one hand, the general objectives of this guideline preventing soil contamination in the ELV sector are:

- Providing a background paper so that owners and managers of ATF can operate safely, responsibly and respectfully with the surrounding environment.

- Proposing real solutions concerning the risks taken during ELV management which can produce dumping. The priority objective is to avoid final treatments when the soil is polluted which will lead to extra cost and reduce effectiveness.
- To actively raise awareness for managers in this sector on the importance of good operational and environmental practices regarding subsoil quality.
- In short, combine a necessary industrial activity with maximum respect for the environment and people's health.

On the other hand, the specific objectives are:

- Identification of the critical zones inside the ATF which can produce soil contamination. Making a diagnosis through a personalized checklist.
- The evaluation and minimization of potentially polluting processes of the subsoil in ELV sector during the different phases of the ATF: design, operation and dismantling.
- The development of an innovative risk assessing methodology. Combine damage of the productive processes and vulnerability of the environment in order to provide a powerful tool for further implementation by the administration.

3. Background

Before the 1990s, prior the appearance of current regulations for ELV, cars were deposited in old scrapyards. These facilities were usually small family businesses, professionally unskilled and with few staff member. It is in those facilities that srcaps and some components were obtained and dismantled to put in the market, initially those with greater economic value and easier sale. Scrap parts used to be given more importance than the own spare. Eventhough, pieces were disassembled by the buyer at the scrapping facilities using their own tools, the rest was taken to shredders, where the product needed by the steel industry was obtained: scrap metal.

From an environmental point of view, scrapping did not create any potentially polluting waste, unless it was economically profitable, as was the case of batteries for the value of lead, leaving the oil and other liquids in the remains of the vehicle. On the other hand, shredders did not separate ferrous metals from nonferrous metals, because their technology and their costs did not allow it at the time.

All of this constituted a serious problem because these residues had a high content of dangerous elements, besides being highly flammable such as combustible products. It was therefore not surprising, that certain administrations started to regulate and define legal aspects of this activity for environmental reasons. Specifically, the problems that occurred were: discharges of hazardous liquids during the phases of operation and storage which could cause contamination of the soil and groundwater by filtration (fuel, oils, cooling liquids, etc.), discharges of products and non-reusable liquids inside the installations (wires, plastics, non-recoverable liquids, etc.), wastewater contamination, atmospheric emissions (particles and dust), noise pollution and landscape pollution due to the activity.

ELV legal framework

Management of end-of-life vehicles in Spain has undergone in the last decade a deep process of reconversion motivated by the publication on 3 January 2003 of *Royal Decree 1383/2002*, of December 20, on vehicle management at the end of its useful life, which transposed *Directive 2000/53/EC* into Spanish domestic law. All the facilities that were part of the treatment chain of the ELV had to adapt to the requirements set out in the RD. One of the main objectives of this regulation was to establish measures to prevent the generation of waste from vehicles, regulated their collection and decontamination at the end of their useful life, as well as other treatment operations, in order to improve the efficiency of Environmental protection throughout the life cycle of vehicles. Thus, one of the guidelines proposed was to set targets for reuse, recycling and recovery, which were expected to achieve a reuse and recovery of at least 95% of the average weight per vehicle in 2015 and a reuse and recycling of at least 85% of the average weight per vehicle. Vehicle manufacturers were also required to take preventive measures in the manufacturing process, such as limiting the use of hazardous substances, designing and manufacturing vehicles in a manner that facilitates dismantling, decontamination and recovery or included recycled materials in the manufacture of vehicles.

Following this same line of work, *Royal Decree 1383/2002* was recently replaced by *Royal Decree 20/2017*. This new regulation contains very ambitious sections that go beyond European legislation, such as the specific objectives for ATF that encourage preparation for reuse. Since the entry into force of the regulations, authorized treatment facilities must reuse parts and components which account for at least 5% of the weight

of the vehicles they have treated annually until 1 January 2021, 10% from that year date until January 1, 2026 and 15% from that date onwards. It also enhances the chain of recycling of authorized managers and improves the traceability of each vehicle, so that there is a follow up since it becomes waste until its complete treatment.

Regarding Catalan legislation, *Decree 217/1999*, of July 27, legislates for the first time the management of out of use vehicles due to the huge impact that this type of waste generated on the environment. Although it was drafted in 1999, before the emergence of the current legislation at European level, it includes very innovative aspects concerning about soil protection during the storage, decontamination and pressing of vehicles.

Soil and waste legal framework

Soil is one of the most sensitive and vulnerable receptors of contamination. *Royal Decree 9/2005* is developed with the purpose to establish a list of activities that may cause soil contamination, and to adopt criteria and standards for declaring that sites are contaminated. These activities are set out in Annex I of the Royal Decree and are codified by the National Code of Economic Activities (CNAE).

According to the actualization of the CNAE that is expected to be published this year, ELV management and recycling facilities can be catalogued under the following codes:

3812 Waste collection. Collection of hazardous waste

3821 Waste treatment and disposal. Treatment and disposal of non-hazardous waste

3831 Materials recovery. Dismantling of wrecks

3832 Materials recovery. Recovery of sorted materials

4677 Wholesale of waste and scrap

In addition, the owners of the activities listed in Annex I of the *RD 9/2005* will be obliged to forward to the competent body of the corresponding Autonomous Community, a preliminary situation report (IPS) for each of the soils in which this activity is carried out.

4. Legal framework

4.1.- END-OF-LIFE VEHICLES

Europe	***Directive 2000/53/EC***, of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles - Commission Statements. Last modification: Commission Directive 20016/774/EU of 18 May 2016 amending Annex II to directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles.
Spain	***Royal Decree 20/2017***, of 20 January, on end-of-life vehicles.
Catalonia	***Decree 217/1999***, of 27 July 1999, on the management of end-of-life vehicles.

4.2.- OTHER REGULATION OF WASTE AND CONTAMINATED SOILS

The ELV normative is complemented with the following regulations:

- *Royal Decree 9/2005*, of 14 January, which establishes a list of potentially soil contaminating activities and criteria and standards for declaring that sites are contaminated.
- *Law 22/2011*, of July 28, on waste and contaminated soils.
- *Legislative Decree 1/2009*, of 21 July, approving the consolidated text of the Law regulating waste in Catalonia.
- *State Plan for Waste Management (PEMAR) 2016-2022*, approved by the resolution of November 16, 2015, of the General Directorate of Quality and Environmental Assessment and Natural Environment.

4.2.1.- Sector-specific legislation

- *Royal Decree 1619/2005*, of 30 December, on management of used Tyres.
- *Royal Decree 679/2006*, of 2 June, regulating the management of used industrial oils.
- *Royal Decree 106/2008*, of 1 February, on batteries and accumulators and on the management of their waste.
- *Royal Decree 110/2015*, of 20 February, on Waste Electrical and Electronic Equipment (WEEE).
- *Royal Decree 115/2017*, of 17 February, regulates the commercialization and handling of fluorinated gases and equipment, as well as the certification of the professionals who use them and lays down the technical requirements for installations that carry out activities emitting fluorinated gases.

5. End-of-life vehicles management

Nowadays, end-of-life vehicles are defined by the Spanish Ministry of Agriculture Fisheries, Food and Environment (MAPAMA) as those that have become waste. They must end their life in an authorized treatment facility where the certificate of destruction is issued.

5.1.- STATISTICS

A statistical study of the ELV sector in Catalonia has been done in order to visualize the changes in the last years.

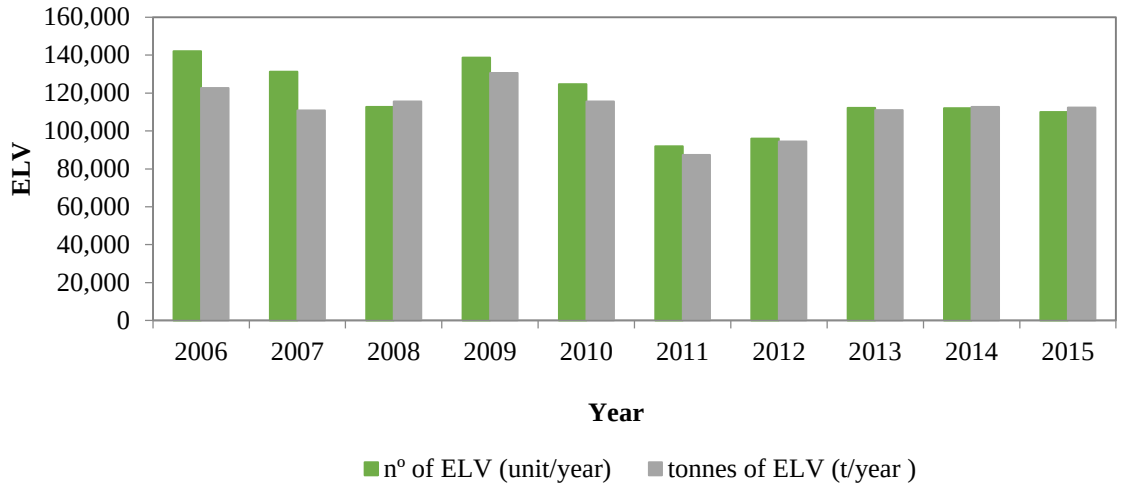


Figure 2. Number of ELV treated per year in Catalonia. Source: ARC (2017)

Scraping old cars is an activity which creates revenue. In addition to economic benefits, the current society is slowly changing its mentality of consumption and turning towards recycling and recovery. In recent years, this movement has gained more and more supporters, and the trend is known as Circular Economy.

By analising Figure 3, it is possible to confirm that despite the decrease in number of ELV treated in Catalonia per year, the number of facilities treating these vehicles as well as their capacity is increasing. The result could be due to the waste management hierarchy and the new recycling - recovery targets established by the Spanish Law 22/2011, on waste and contaminated soils. In addition, those numbers might have been caused by the Spanish plans to remove old age vehicles fleet, which was 11.6 years old in 2015. Finally, the World financial crisis in the recent years might have been important factors leading to this changes.

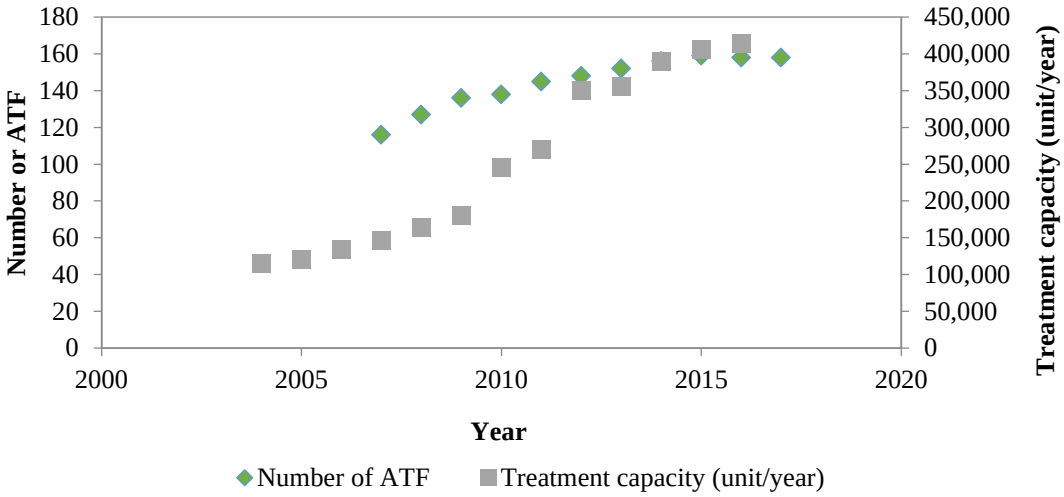


Figure 3. Treatment capacity of ELV in Catalonia. Source: ARC (2017)

5.2.- ELV TREATMENT

Once the vehicle arrives at an ATF, it is deposited in the receiving area, where it is stored and subsequently subjected to decontamination, scrapping and compaction operations. The scrap pieces in good conditions are recovered for reuse and trading, according to the new RD. While other components which can not be reintroduced into the market, are firstly treated from the environmental point of view recycling as opposed to other forms of valorisation. Additionally, it is recommended to follow the same hierarchy of waste management for the fluids extracted from the vehicle: fuels, oils, refrigerants, antifreeze and other liquids removed from the ELV.

Several processes are carried out each step of the ELV treatment (see attachment to Annex II). As it was said before, the objective of this paper is to detect which process can affect to a greater level the quality of the subsoil and to propose preventive measures. The study of the different zones of an ATF is organised below.

5.2.1.- Receiving and storage zone of ELV

According to the current legislation, vehicles are considered waste when they are submitted into an ATF and destruction certificate have been issued.

ELV are considered hazardous waste by the European Waste Catalogue (CER). They are codified as "*16 01 04: end-of life vehicles*" and the related treatment code is *"V55: Recycling and recovery of end-of life vehicles".*

5.2.2.- Decontamination zone

Fluids and hazardous elements are removed from the vehicle, except when they are needed for further use of pieces or components.

Once the hazardous waste has been removed, the vehicle is classified by the European Waste Catalogue (CER) as *"16 01 06: end-of-life vehicles which do not contain liquids or other dangerous components"*.

Hazardous waste removed from the ELV in the decontamination zone

The substances which need to be removed and stored separately from the vehicle are shown in Table 1 and Table 2. The ATF also has the responsibility to manage them as hazardous waste.

Table 1. Hazardous solid waste from ELV decontamination

Hazardous components		**LER code**	**Indicative management route**
Solids	Fuel filters, rags and absorbents impregnated with dangerous substances	15 02 02	V13/V41 - T24/T21/T22/ T13/T31
	Unpressed oil filters	16 01 07	V22/V41
	Mercury components	16 01 08	T13
	PCB / PCT capacitors	16 01 09	T22/T32
	Explosive components	16 01 10	V42 - T32
	Brake pads containing asbestos	16 01 11	T13/T32
	Components and materials which contain lead, mercury, cadmium and / or hexavalent chromium (Ni-Cd batteries) in accordance with Annex II of Royal Decree 1383/2002 of 20 December.	16 01 21 16 06 02	V24 - T13/T21/T32 V44
	Batery	16 06 01	V44
	Catalyst[1]	16 08 02 16 08 07	V41/V48 - T31/T33/T12/T13 V41/V48 - T13/T21/T33

[1] Catalysts can also be seen as non-hazardous under the code 16 08 01 "*Used catalysts containing gold, silver, rhenium, rhodium, palladium, iridium or platinum (except catalysts with code 16 08 07)*".

Table 2. Hazardous liquid waste from ELV decontamination

Hazardous components		LER code	Orientative management route
Fluids	Gasoil Gasoline Other fuels (including mixtures)	13 07 01 13 07 02 13 07 03	V61/V23
	Transmission fluids and other hydraulic oils, engine oils, differential and gearbox oils	13 01 10 13 01 11 13 01 12 13 02 05 13 02 06 13 02 07 13 02 08 13 08 99	V22 V22 - T21 V22 - T21 V22 V22 - T21/T22 V22 - T21 V22 - T21 -
	Brake fluid	16 01 13	V21 - T21
	Antifreeze and cooling fluids	16 01 14	V21 - T21
	Air conditioned fluids, from liquefied gas tank and any other hazardous fluid	16 05 04	V24 - T32/T21/T22

The guidance management routes included in Table 1 and

Table 2 can be seen in the Annex I. Indicative management routes

5.2.3.- Waste storage zone

Waste generated during the ELV decontamination must be stored properly. Using different containers for each fluid or solid. It is important to pay attention to this zone from the point of view of soil contamination.

5.2.4.- Dismantling zone

After decontamination, the dismantling, removal and classification of ELV components is carried out. For instance, it can be reused and/or destined for commercialization: tires, engines, bumpers, dashboards, fuel tanks, glass, carpets, textiles, etc.

This area will not be necessary as long as the ATF guarantees, through other ATF, a minimum level of reuse. It is usual to correspond with the decontamination zone.

5.2.5.- Storage of components zone

Removed components and pieces from the dismantling zone are stored neatly. This area will not be mandatory as long as the ATF guarantees, through other ATF, a minimum level of reuse.

5.2.6.- Storage of ELV decontaminated zone

Decontaminated and dismantled ELV are stored in a specific area. They remain waiting for some further treatment, such as compaction, fragmentation or direct transfer to an ELV after treatment facility.

5.2.7.- Compaction zone

ELV pressing after decontamination and removal of all the components that can be reused or recycled. This zone will only exist when the ATF chooses to compact the vehicles before their shipment to the shredder plant.

5.2.8.- Shredding and postshredding zone

It is during fragmentation and postfragmentation that shredding takes place as well as the separation process (see attachment to Annex III. Shredding and postshredding). This procedure makes the recovery of the different materials possible. It is not mandatory for ATF to have areas of fragmentation and postfragmentation, they can be sent to external facilities which are exclusively dedicated to these operations. But it is mandatory for decontaminated and dismantled ELV (compacted or not) to be sent to fragmentation.

Consequently, the life cycle of the ELV in an ATF can be seen in Figure 4.

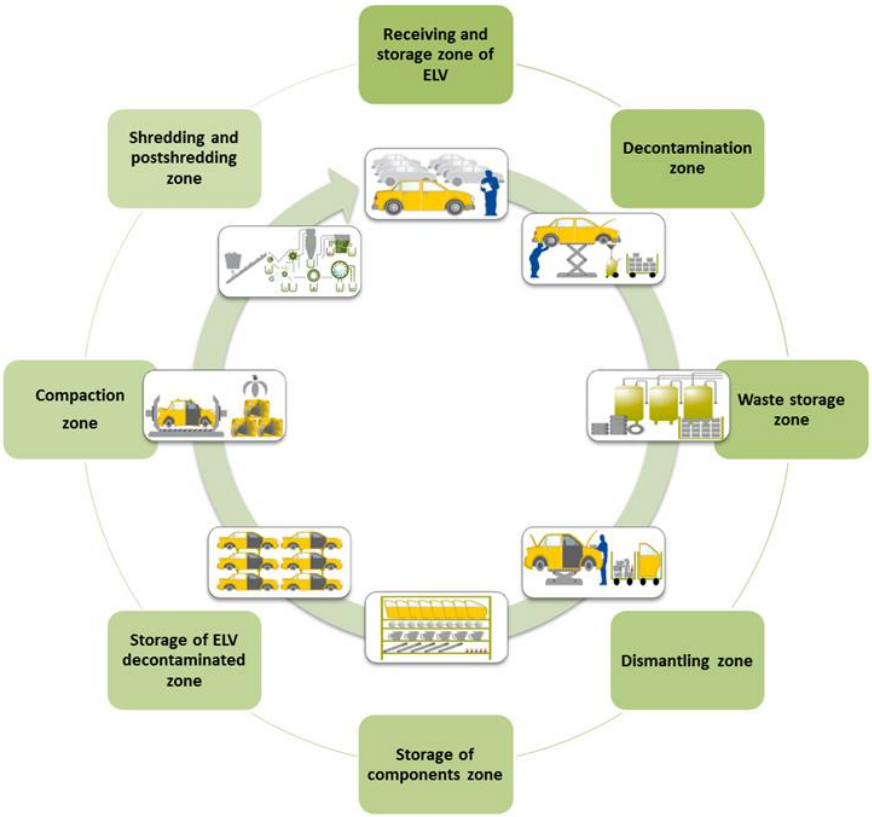


Figure 4. Life-Cycle of ELV in an ATF

5.3.- POTENTIAL IMPACTS

One of the main objectives of this guidance for the ELV sector is to identify critical operations which may cause subsoil pollution and to propose solutions and measures to minimize the impact on the environment and human health.

All operations carried out in the ATF involve the generation of a large amount of highly hazardous waste. This may enhance environmental consequences that must be taken into account during the design, operation and dismantling phases of the installation.

- Soil contamination: May be due to the accidental (or not) discharge of substances during the ELV treatment and/or storage of the removed substances. But also, to the leaching of rainwater that could carry polluting substances (See Figure 5).
- Groundwater contamination: Usually associated with soil contamination. When the soil layer is porous, permeable and does not have enough thickness. The contaminants dragged by the rainwater may leak during the natural percolation process until reaching aquifers or underground wells.
- Generation of contaminated waste water: It is necessary to collect and treat water properly within the facility due to possible contaminant peaks. Because if it is directly dumped to the urban sewerage system it can collapse the corresponding Wastewater Treatment Plant (WWTP).
- Atmospheric pollution: Due to particles and dust that is generated during the transfer of ELV inside the installation and in the compaction and fragmentation zones.
- Noise pollution: Due to specific processes.
- Light pollution: Artificial illumination in the stored vehicle field during the night can disturb the properties of the receiving medium hindering the view of the sky.

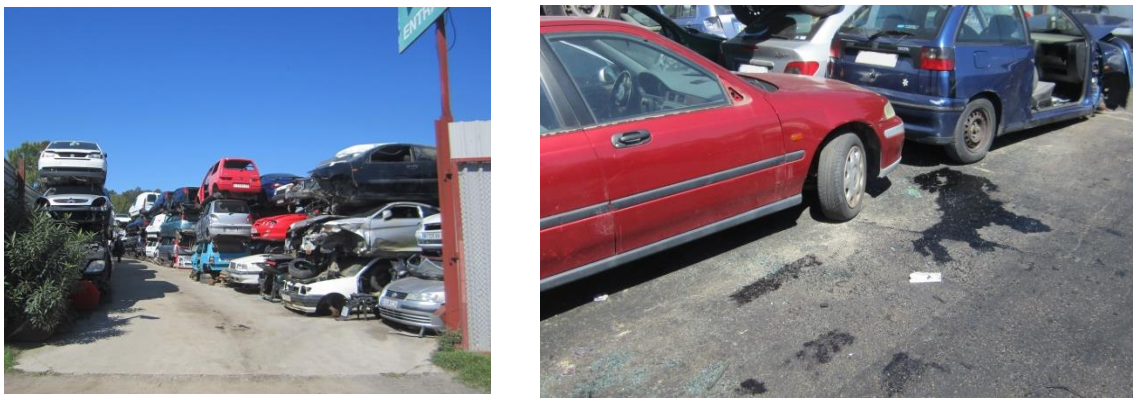


Figure 5. Impacts produced by ELV management

The most common critical operations causing subsoil pollution during the operation phase will be carefully study, especially those in where fluids are managed. In addition, some preventive, control and operation measures will be proposed.

6. Diagnosis

The fieldwork was done in collaboration with the ARC, and assessed eight ATF located in Catalonia. The objective of this work has been to identify and evaluate the most critical operations carried out during the ELV treatment. These ATF have been chosen to cover all the facilities placed in Catalonia in a representative way.

Table 3 shows a brief summary of the ATF visited. Most of them entered into service in 2000. It can be seen in a confidential mode, data of the treatment capacity (units/year), the different zones in them (numbers are in accordance with section 5.2) and if the ELV treatment is the principal activity in the facility (primary) or if it is not (secondary).

Table 3. Summary of ATF visited

	Treatment capacity (Units/year)	**Zones**								**Type of ELV activity**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Primary**	**Secondary**
ATF 1	680	X	X	X	X	X	X			X	
ATF 2	2.300	X	X	X	X	X	X			X	
ATF 3	2.500	X	X	X	X	X	X			X	
ATF 4	6.000	X	X	X	X	X	X			X	
ATF 5	22.000	X	X	X	X	X	X	X		X	
ATF 6	6.000	X	X	X			X		X		X
ATF 7	30.000	X	X	X			X		X		X
ATF 8	50.000	X	X	X			X	X	X		X

The impact generated on the subsoil has been evaluated through the checklist attached in Annex IV. It is used as a qualitative method to evaluate the negative impacts into the subsoil. It includes the first seven zones of section 5.2, excluding the shredding and post shredding zone. It has also been subdivided according to the different processes which take part in each zone. In addition, specifications presented in the current *Law 20/2017* are shown in yellow colour. The evaluation is organised as follow: four boxes with the following description: *excellent, good, poor* and *does not have*. The parameters used to describe each of them can be seen in Table 4.

Table 4. Checklist evaluation criteria

Excellent	It has a very good level of conservation in all the aspects, goal of any ATF
Good	It is fine but it can not be considered as perfect because of its conservation status or operating conditions
Poor	It has something that could be improved
Does not have	It does not have this operation or feature

The results of this work can be seen in Annex V. Having assessed these eight ATF and analysed the completed checklist, it was discovered that more than a half of the points assessed (58%) are suboptimal or does not exist. Only 11% are excellent and 31% are good (Figure 6). It shows at first glance how many improvements can be done in this sector. Another conclusion of this evaluation is the detection of the most critical zones, which can have a negative impact on the subsoil (Figure 7). They are:

- Decontamination zone (Figure 8)
- Waste storage zone (Figure 9)
- Compaction zone (Figure 10)

It should be pointed out that compaction zone is not one of the worst scored in the study. It might be because only two ATF own this operation. Despite this, it has been decided to consider it in this part because of the entailing danger. When a vehicle is decontaminated, the deposits of the fluids are emptied but a percentage of the liquid always remained in the ELV. Therefore, when vehicles are crushed in the compactor it produced a discharge of hazardous fluids into the soil when there are not control measures to prevent soil and consequently groundwater contamination.

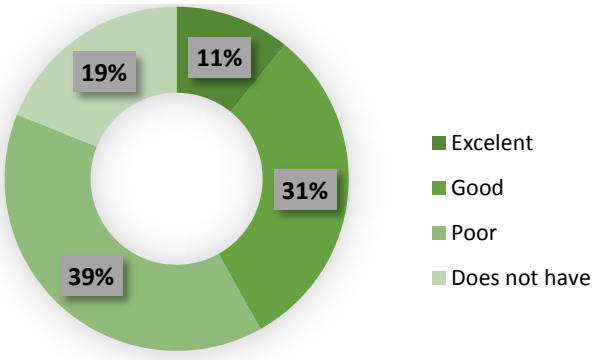


Figure 6. Analysis of the conditions-operations in the ATF studied

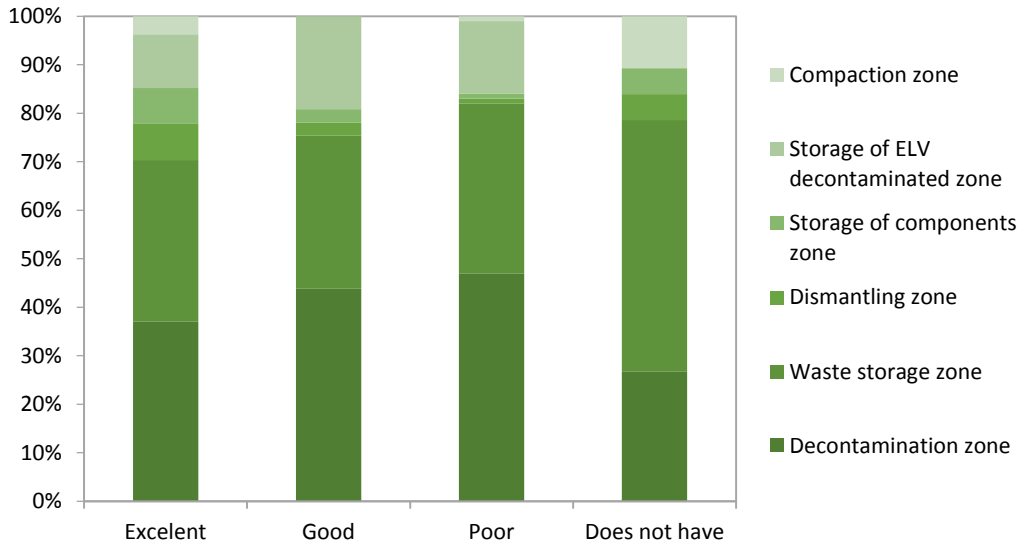


Figure 7. Analysis of the ATF zones

With regards to operations, the most dangerous for subsoil are those in which operators deal with fluids as well as their storage. Identify this problem is the first step that will enable to propose measures for preventing subsoil contamination.

Figure 8. Decontamination

Figure 9. Waste storage

Figure 10. Compaction zone

7. Quantification - Risk assessment

It is well known that risk is a combination of damage and frequency. With regards to this combination, the next part of this research is concerned with a risk assessment for the ELV sector. In this particular case, the frequency will be replaced by vulnerability (Equation 1). This change has been made taking into account the further implementation of this quantification in the content of the Preliminary Situation Report (IPS).

$$Risk = Damage \cdot Vulnerability \qquad \text{(Equation 1)}$$

Afterwards, the global risk of the facility will be quantified graphically representing the respective factors of damage vs vulnerability.

7.1.- DAMAGE

The estimation of damage has been calculated following the Enviros methodology, which is included in the bibliography as: *Development of a methodology for quantifying the information contained in the Preliminary Situation Report (IPS) which has to be submitted by potentially soil polluting activities under the Royal Decree 9/2005.* This methodology is based on the IPS quantification fields to evaluate the damage.

In a first phase the damage caused by the eight ATF studied has been assessed. While doing this operation, huge variations between them have been detected. Mainly because each of the ATF fills the IPS document in a different way and the contained data is not complete enough to obtain reliable results. Due to this analysis it has been decided to do a model IPS for a standard ATF using an average of the available data. The characteristics of the facility chosen are:

Materials	Treatment capacity of 14.000 ELV/year, half gasoline and half gasoil. In addition, it also is receiver of gasoil
Products	There are no hazardous products.
Waste	14 residues registered, according with the RD 20/2017 specifications
Surface storage	Contaminated and decontaminated ELV zones for storage, solid and liquid waste, out of use tyres and spare pieces/parts for reuse and marketing
Surface deposits	Gasoil and gasoline deposits
Underground deposits	One deposit for self-consumption gasoil
Processes	Decontamination, dismantling and compaction zone, a petrol station for diesel self-consumption and a hydrocarbon separator for water treatment
Historical activity	First activity of the location, started 17 years ago

Apart from the amounts used in each case, the complete data quantified are shown in Annex VI.

In addition to standard ATF explained before (case 1) it has been experimented with a low treatment capacity ATF (case 2), which are the most usual in Catalonia and Spain. Finally, the las case is based on a high treatment capacity ATF without good environmental measures to prevent contamination (case 3). This last case will allow establishing the upper limit of damage. In order to evaluate this data graphically, a classification has been implemented using the factors of Table 5.

Table 5. Allocation of damage factors

Damage score	Factor
>140,000	10
100,000 - 140,000	8
80,000 - 100,000	6
60,000 - 80,000	5
30,000 - 60,000	3
30,000>	1

7.2.- VULNERABILITY

In this second part, the vulnerability of the facility environment has been evaluated. The developed methodology is based on a previous study made for the Department Management and Contaminated Soils, ARC (2016). The selected variables have been chosen regarding the vulnerability of the environment and the possible impact produced on subsoil. These layers have been implemented in the QGIS, free software of Geographic Information System (GIS).

Regarding Table 6 it must be done some clarifications about the quantification:

Natural heritage	If there is more than one area of protection scores are added. Therefore the maximum rating for this parameter is 1920 points
Surface water	If there are more than one item scores are added
Ground water	If there is more than one aquifer at different levels in the same area of land it is used the higher score.

A list of the abbreviations used in this chapter can be seen below. For further explications see Annex VII.

x	Distance from the facility in kilometres (km)
k	Coefficient of permeability in metres per day (m/d)
R	Average of annual rainfall in millimetres per year (mm/y)
s	Slope in percentage (%)
p	Population in number of inhabitants (inh.)

Table 6. Vulnerability quantification. Source: ARC (2016)

Field		Risk	Points
Natural heritage		PEIN	480
		Avifauna protection zones	480
		Areas of *flora and fauna* concern	480
		Geological heritage	480
Surface water (within a radius of 5 km)	River	High (x < 1 km)	2,400
		Medium (3 km > x > 1 km)	800
		Low (x > 3 km)	270
	Lake	High (x < 1 km)	1,600
		Medium (3 km > x > 1 km)	530
		Low (x > 3 km)	170
	Reservoir	High (x < 1 km)	1,600
		Medium (3 km > x > 1 km)	530
		Low (x > 3 km)	170
Ground water (within a radius of 5 km)		High	2,400
		Medium	800
		Low	270
Permeability (k)		High (k > 1 m/d)	2,400
		Medium (1 m/d > k > 10^{-4} m/d)	800
		Low (10^{-4} m/d > k)	270
Average of annual rainfall		High (R > 1000 mm/y)	2,400
		Medium (1000 mm/y> R > 500 mm/y)	1,200
		Low (500 mm/year > R)	600
Slope		s > 40 %	1,600
		40% > s > 20%	530
		20% > s > 10%	170
		10% > s	50
Municipalities distance		High (x < 1 km)	2,400
		Medium (3 km > x > 1 km)	800
		Low (x > 3 km)	270
Municipalities inhabitants		High (p > 50000 inh.)	2,400
		Medium (50000 inh.> p > 5000 inh.)	800
		Low (5000 inh. > p)	270

Finally, the hazard due to the ATF environment is the sum of all the parameters evaluated in Table 6. This data is classified in the same way as the damage, giving a vulnerability factor to the final score (Table 7).

Table 7. Vulnerability factors of the environment.

Vulnerability score	Factor
>20,000	10
20,000 - 15,000	8
15,000 - 12,000	7
12,000 - 9,000	5
9,000 - 6,000	4
6,000 - 3,000	2
3,000>	1

7.3.- RESULTS

An evaluation of the vulnerability has been decided in the 8 emplacements studied using the same value of damage (case 1). This will enable to compare the risk for soil contamination of the same activity in the different locations (Figure 11).

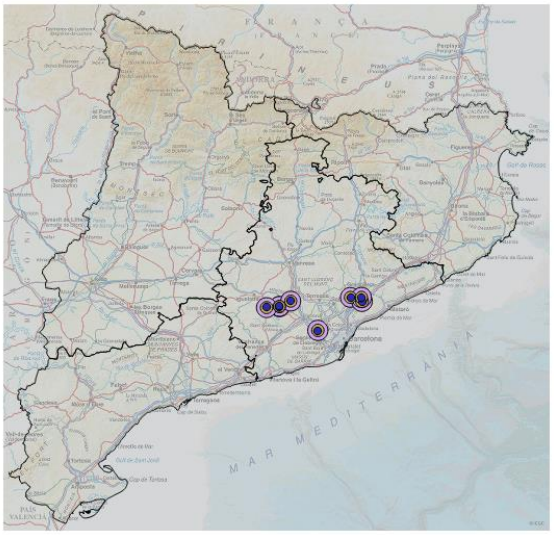


Figure 11. Locations of the 8 ATF studied with buffers of 1 km, 3 km and 5 km.

On the one hand, the results of evaluating the damage in the three cases explained are shown in Table 8. In the quantification of the risk is used the first case, obtaining a value of 67,030 which according to Table 5 it is assigned a value of 5.

Table 8. Damage results

Case	Treatment capacity (ELV/year)	State of the facility	Score (Damage units)	Factor
1	14,000	Good	67,030	5
2	2,500	Quite good	58,570	3
3	50,000	Very poor	135,570	8

Analysing Table 8 it is possible to detect that the total score is not proportional to treatment capacity. The explication of this fact is mainly due to the differences in the production (compaction and petrol station), the underground tanks and the conditions of the storage of waste and the facility.

On the other hand, the vulnerability assessed for the eight emplacements is evaluated following the previous methodology (explained in Table 6). QGIS is a powerful tool which enables to evaluate all the parameters accurately. Therefore, the layers employed are shown in figures 12-18.

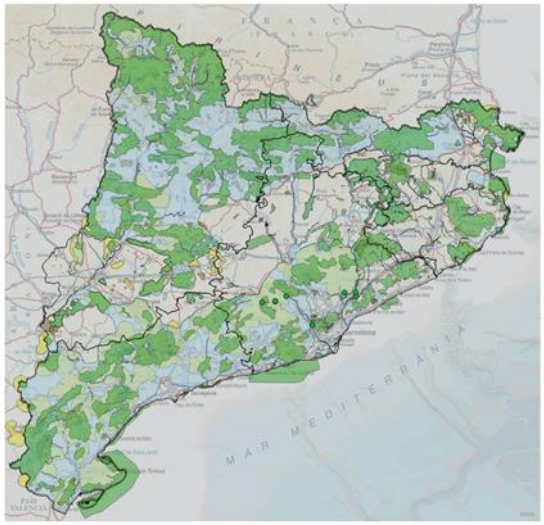


Figure 12. Natural heritage

Figure 13. Surface water

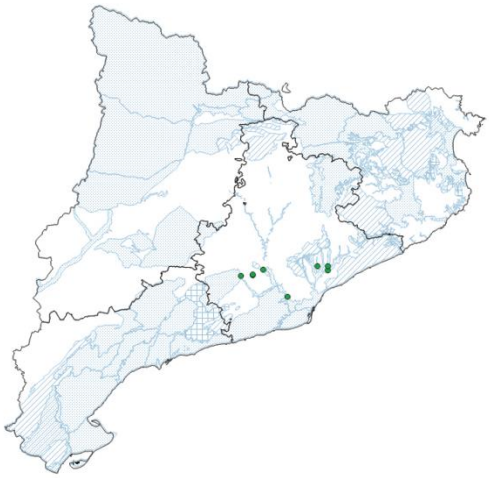


Figure 14. Ground water

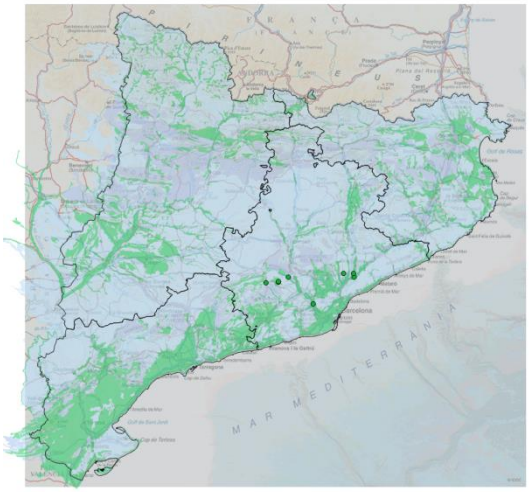


Figure 15. Permeability

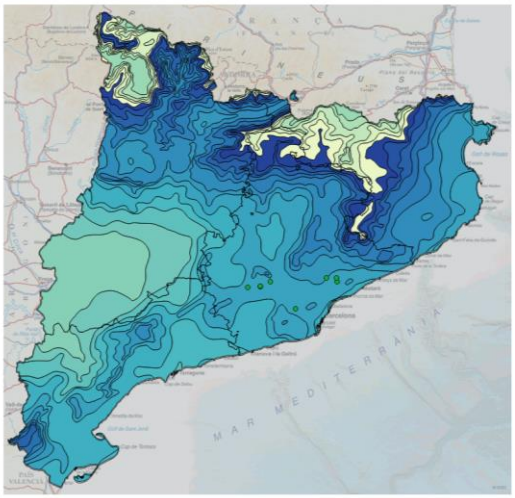


Figure 16. Average of annual rainfall

Figure 17. Municipalities

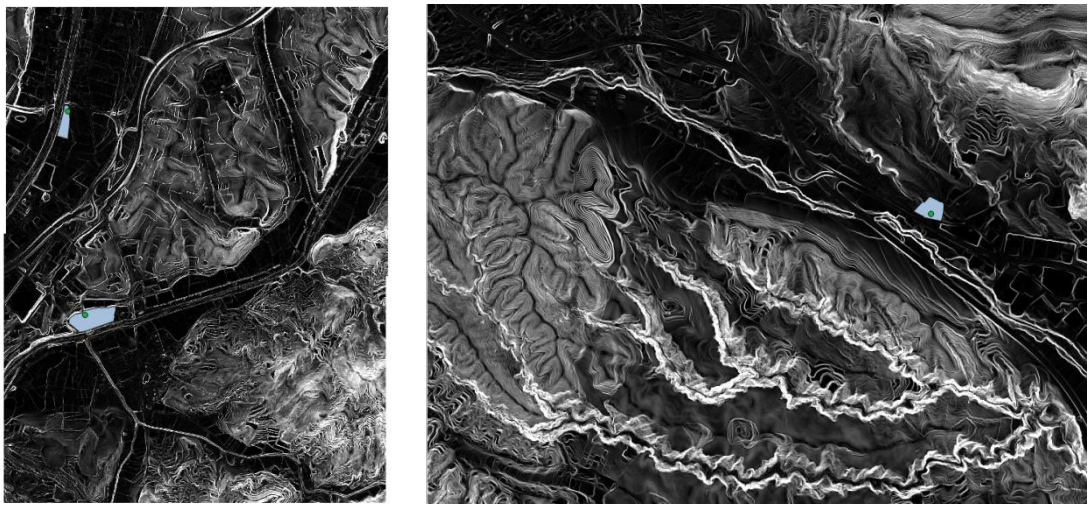


Figure 18. Slope

Results obtained for the vulnerability are shown in Table 9 (full details are available in Annex VIII). The most vulnerable ATF is number 4, which obtains a punctuation of 12,560. Compared to the fieldwork, it reflects a reliable methodology that accurately evaluates the vulnerability of the receiving environment.

Table 9. Vulnerability results

ATF	Score (Vulnerability units)	Factor
1	8,350	4
2	9,480	5
3	6,750	4
4	12,560	7
5	11,600	5
6	10,530	5
7	10,070	5
8	11,120	5

Equation 1 is used to combine the numerical results obtained for damage and vulnerability. In Figure 19 can be seen the studied risk associated to standard ATF situated in different industrial locations within Catalonia. The intention of the colour gradation is to represent the level of risk. There are mainly three zones of division:

High risk area	Where risk reduction measures should be implemented, regardless of the associated cost.
As low as reasonably practicable area (ALARP)	Although this region is tolerable it should be reduced to the lowest feasible levels without incurring disproportionate costs.
Moderate risk area	The level of risk in this zone is insignificant. This would be the ideal position.

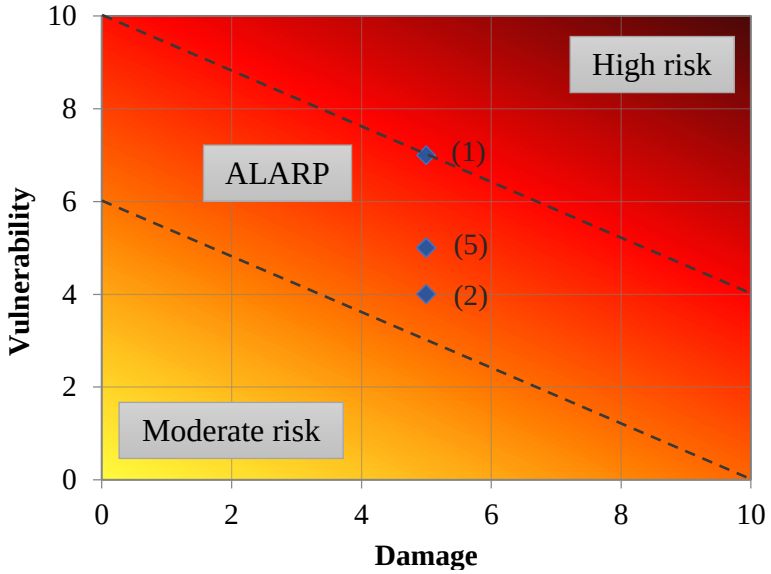


Figure 19. Representation of the results obtained

It must be emphasised that these results are not completely real because they have been obtained as a combination of a calculated average damage applied to real locations. In that way can be observed in Figure 19 that only one of the ATF is situated on the border of high risk area, while all of the others are in the ALARP area. Consequently, all of them could reduce the risk of subsoil contamination, but as it is impossible to change the vulnerability factor (the facility has already been built) the only option to risk decrease is the reduction of the damage. This could be done by implementing some environmental aspects of the installation, which will be detailed in the following section. In the Figure 20, supposing a change from 5 to 3 in the damage (coinciding with the case 2 studied) some of the facilities would be already in the ALARP area but with more acceptable risk.

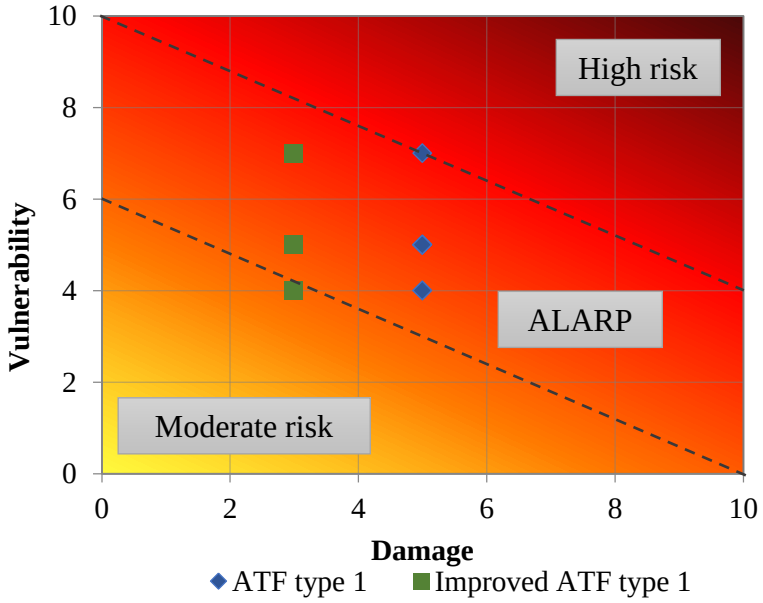


Figure 20. Results corrected with the reduction of damage

Most of the times the reduction of the risk is possible, because as it has been seen in the fieldwork, this type of facilities has a lot to improve. On the one hand, the soil status is very poor in most of the cases because these facilities are quite old. On the other hand, the storage zone is not managed as it should, with prevention and control measures to effectively reduce the risk of contamination of the subsoil.

8. Prevention of subsoil contamination

The last part of the research is concerned with the prevention of soil contamination. Keeping in mind the waste management hierarchy adopted by Law 22/2011 the prevention concept can be applied together to prevention of waste produced and prevention of subsoil contamination.

The existence of an HSE (Health, Safety & Environment) person in charge is strongly recommended. Furthermore, the implementation of a certified environmental management system (ISO 14001 or EMAS) will also enable to monitor and reduce continuously the environmental impacts generated.

8.1.- PREVENTION IN ATF DESIGN

Every year, end-of-life vehicles generate between 7 and 8 million tonnes of waste in the European Union which should be managed correctly (European Commission, 2016). Prevention of waste produced is mainly an issue of vehicle producers. That is why *Royal Decree 20/2017* includes in *Article 4*: *Obligations concerning the prevention of waste and the placing on the market of vehicles*. They are essentially:

- To design their products limiting the use of hazardous substances in their manufacture and to facilitating the dismantling and treatment of waste.
- To provide information to managers, consumers and public administrations.
- To organize and finance where applicable, collecting and an appropriate treatment, either by themselves or through voluntary agreements with other economic agents.

Even so, in this section some possible management and operational improvements for ATF based in IHOBE (2004) and SIGRAUTO (2012) have been suggested. The main objective of this part is to reduce the generation of waste and combine this industrial activity with maximum respect for the environment taking care of subsoil.

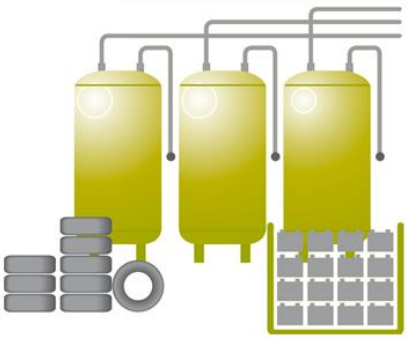
Receiving and storage zone of ELV

- Must have the appropriate dimensions according to the number of vehicles stored, the calculations must be performed depending on the authorized treatment capacity. Taking into account do not store vehicles more than 30 days in this zone.
- A space of between 8 and 10 m^2 per vehicle is recommended. IHOBE (2004)
- It is recommended to cover this area in order to avoid possible spills of vehicles that are in poor condition.
- Soil must be paved and waterproofed.
- It must have a system of collection and wastewater treatment, including rainwater, which must be treated in accordance with health and environmental regulations. In addition, equipment for spill collection, decantation and separation of fats.

Decontamination zone

- Covered area with impermeable pavement.
- A minimum surface area of 200 m^2 is recommended. IHOBE (2004)
- Installations for the collection of possible spills (blind pits) and fat decantation-separation system. In addition to other pollution prevention instruments, such as retention tanks or drip trays.
- It is recommended to have a fire protection system.

Waste storage zone

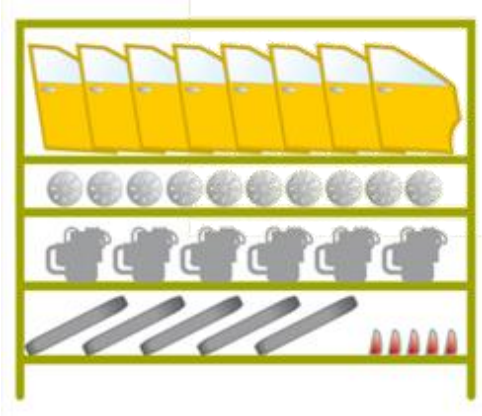


- Area covered and provided with impermeable pavement, at least, for deposits of hazardous waste.
- Suitable tanks for storing separately the fluids extracted from vehicles and containers for storing solid waste. It is very important not to mix residues that may be incompatible.
- Appropriate area for storing Out of Use Tires (NFU), which includes fire protection measures and prevention of risks arising from excessive storage.

Dismantling zone

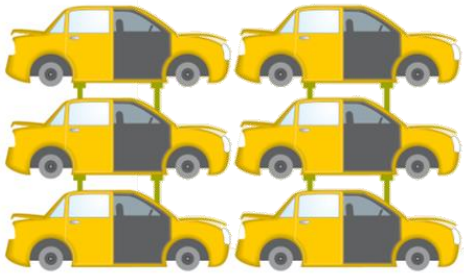
- Covered area with impermeable pavement, suitable for the number of vehicles to be dismantled
- Installations for the collection of possible spills and fat decantation-separation system.
- It is advisable to have a fire protection system as well as first aid kit.

Storage of components zone



- Covered area with impermeable pavement, suitable for the number of components to be stored.
- Containers or impermeable containers for the storage of those parts that can retain traces of oils, fats or other fluids.
- It is recommended to carry out an initial study to decide, which parts or components of the vehicle should be dismantled for reuse as second hand spare parts. As well as, determine which is the optimum stock to be kept in the warehouse.

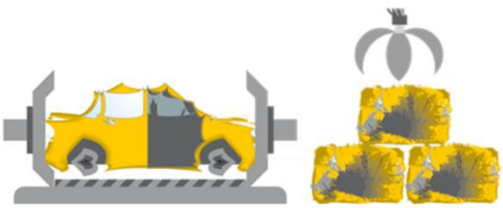
Storage of ELV decontaminated



zone

- Impermeable pavement with slopes towards the collection points to prevent soil contamination.
- System of collection and wastewater treatment, including rainwater, which must be treated before discharge.
- This area must be fenced or closed around its perimeter. Depending on the environment, especially if it is a non-industrial area, plant enclosures may be more appropriate.
- It is recommended to have a fire protection system.

Compaction zone



- Impermeable pavement with slopes towards the collection points of wastewater to prevent soil contamination.
- System for collection and wastewater treatment, including rainwater, which must be treated before to discharge.

In addition to these guidelines, it is important to comment some improvements for the most critical pollution sources in these facilities:

- It is recommended to build the ATF on a paved and waterproofed soil. Concrete could be a good material to use. It is also recommended to use a superficial layer of epoxy resin at least in decontamination and waste storage zones.
- In addition it is very important to maintain all the zones except the storage of ELV decontaminated and shredding and postshredding covered. This measure is emphasised for the receiving and storage zone. Because in many cases, when the ELV arrives to the treatment centre it is in very bad conditions that could lead to contamination. This fact, combined with rainwater could produce a huge quantity of wastewater with hazardous substances.
- Related with the previous point, ATF should have a satisfactory sewerage network. The drains must be distributed through the installation, especially in critical points as the less height points, the perimeter of the facility (in particular the entrance) and also in the decontamination zone.
- Furthermore, it is suggested to have separated networks for the different wastewater collected in the ATF.
    - Rainwater collected in the roof of covered zones could be reused for cleaning or in the fire control system.
    - Rainwater collected in the field of ELV decontaminated must be sent to a treatment system made up of at least a clarifier with fats flotation.
    - Wastewater generated by the staff can be sent to the public sewage because it is, in fact, urban wastewater.
    - Wastewater derived from the cleaning of spare pieces could be reused in the same process if they are treated in a closed circuit. There are small WWTP which can handle this type of wastewater and transform it into clean water.
    - Wastewater collected in decontamination zone is considered as sludge. Therefore, it could be collected in (septic) tanks located below the zone of fluids extraction.

These measures will contribute to save raw resources and to make the business more environmentally friendly while increasing their economic and social benefits.

8.2.- PREVENTION IN ATF OPERATION (CRITICAL ZONES)

Having seen the possible guidelines to implement in the design zone, the next phase is the operation. The practical work done, visiting some ATF located in Catalonia has allowed to detect the critical zones in which the soil contamination may take place: decontamination zone, waste storage zone and compaction zone. In this section are proposed preventive measures in order to preserve the quality of the subsoil.

8.2.1.- Decontamination zone

The operations, which can be seen in Annex II, take place in the decontamination zone. The order in which they are done depends on each ATF. Every operation in which the operators deal with fluids can produce soil contamination due to human failure, but there are also external factors that may get it worse. To prevent this, there are some possible improvements which can be undertaken in the work area (Figure 21). For instance:

- It is a must for this zone to be covered and to hold an impermeable pavement.
- Good quality of the floor in which is performed the decontamination. It should be considered that floor in this zone will be used long hours every day. So, it is highly recommended to use concrete with an epoxy resin to make it more durable over time.
- Clean and organized work environment so that the staff of the ATF could work in good conditions. Avoid having pipeline connexions at ground level.
- It is suggested to have below this area some drains to retain the possible leaks. Apart from that every ATF should have tools for collect and withdrawal this spills, such as reusable rags or sepiolite.
- The zone designed for the compaction of oil and fuel filters must be kept in the greatest conditions as possible.

Figure 21. Decontamination zone and fluid extraction

8.2.2.- Waste storage zone

The storage of waste is considered a critical zone because all the fluids extracted from ELV are considered as hazardous waste (see Table 2). In addition, they usually contain additives, which make them even more hazardous. The most dangerous substances for soil contamination are fuels because of its fluency and mobility, and also oils because of its fouling capacity.

The proposed improvements for the storage of waste are the following:

- Removed liquid waste must be stored in separated containers for each type of waste. They shall be correctly labelled and closed, in a protected area with waterproof surface and a slight slope.
- It is recommended to use above ground tanks in order ease the detection of possible overflows, spills or leaks. It is necessary to use retention systems for containers unless they have double layer, but always on a waterproofed surface.
- When drums are used for storage, they will be arranged leaving a space between them that allows access to all, to facilitate the inspection of possible leaks. These inspections should be carried out weekly, keeping the leak control equipment close to the storage location. IHOBE (2004)
- It is important to control the storage times for hazardous waste in the warehouse in order not to exceed the time allowed, which is six months.
- Most of the residual fuel extracted from the ELV can be reused for the internal use depending on the quality. The supply of this fuel can be done in a small petrol station inside the ATF as long as having systems for control the contamination in the surroundings (Figure 22). The fuel that cannot be reused will be stored temporarily, separately and in the same way sent to an authorized manager.

Figure 22. Petrol station for reused fuel inside the ATF

8.2.3.- Compaction zone

It is mandatory for decontaminated and dismantled ELV (compacted or not) to be sent to fragmentation facilities as their final destination. During the fieldwork it has been discovered how important is the compaction zone in the prevention of soil contamination.

Figure 23. Compactor

In the decontamination of ELV all the hazardous waste is theoretically removed. But in fact, it is impossible to take out all the fluids from their deposits. Therefore, when the vehicle reaches the compaction zone this residual waste dumps into the soil (Figure 23). In order to prevent this it is suggested to use machines with spill collection and also to have a special disposal unit and sewage behind the operation zone. In addition, this residual waste must be sent to a posterior water treatment.

8.3.- PREVENTION IN ATF DISMANTLING

Soil contamination is usually discovered due to two main causes: when the pollutants are found in groundwater because of filtrations or once the facility has finished its activity and a change of soil use take place. So, the last part of these prevention guidelines is to preserve the quality of the subsoil after the ATF dismantling. The improvements suggested are:

- Not to leave on charge deposits or pipes, especially when they are buried. As in some cases ATF include a petrol station, the procedure for leaving out of service storage tanks for liquid petroleum products it is explained in RD 1416/2006.
- Make sure not to leave any type of waste or raw materials in the facility, whether solid or liquid.
- Demolition planning for the industrial building.

- In some cases, it is compulsory to evaluate if there has been subsoil impact due to the activity. When the results of this assess is negative, the owner of the activity has the responsibility to adopt the needed measures. Remove, control, contain or reduce the relevant dangerous substances so that, taking into account the current or future use of the soil no longer entail significant risk to human health or to the environment.

9. Conclusions

- Although there has been some significant improvement in ELV management since the beginnings of this activity there is still a considerable room for improvement. The high vulnerability of the subsoil in the sites attended has been proven. Related with this, new legislation on ELV (RD 20/2017) introduces tougher technical requirements to protect the quality of the subsoil in ATF.
- These facilities are and will be very important in the next decades, because as it is known the society is changing its consumption mentality under the concept of circular economy. And the vehicle fleet is increasingly moving into electric cars, in other words, it means a huge generation of waste (ELV) that must me threated in an appropriate and sustainable way.
- Each ELV contains a huge variety of fluids which can contaminate the soil and are toxic by leaching into surface and groundwater. Therefore, they must be managed correctly, avoiding the transference of contamination to these vulnerable receptors.
- The most critical areas detected in the ATF have been the decontamination zone, waste storage zone and compaction zone. That is why there are proposed some possible measures to avoid subsoil contamination. Obviously, the best tool to reduce soil contamination is preventing it since the beginning, in the design phase of the ATF.
- On the one hand, a deficiency in the new methodology has been detected to evaluate the risk. Due to the lack of data in the IPS it has not been possible to evaluate the real risk of the ATF studied. This problem disappears with the current method for submitting the data in the ARC application. Thanks to this

application it will be possible to implement the evaluation of vulnerability in the risk assessment.

- On the other hand, the results obtained show that despite the fact that the vulnerability of the environment could not change, decreasing the danger produced by the facility itself can reduce the risk. This decrease must be done employing prevention measures in the protection of soil and using appropriate tanks and containers for the storage of waste as well as containment measures to prevent leaks and spills.

9.1.- FURTHER CONSIDERATIONS AND COMMENTS

There are some ideas, which have come up that call for reflection:

- One of the biggest problems which will involve the implementation of the new regulation on vehicles at the end of their useful life (RD 20/2017) will be to meet the objectives of recovery and preparation for the reuse and marketing of parts and components of vehicles proposed.
- Relate with the previous comment it must be pointed out the huge influence that vehicle manufacturers and the automotive lobbies have nowadays. This is not only an issue of parts containing dangerous components for human health and the environment, but also the automotive industry does not contribute to achieving the goal of reducing high levels of pollution.

Annexes

ANNEX I. INDICATIVE MANAGEMENT ROUTES

According to the European Waste Catalogue, the routes of guidance may be: recovery (V) or waste treatment and disposal (T).

Table 10. Indicative management routes

Recovery (V)		Waste treatment and disposal (T)	
V13	Textile recycling	T12	Disposal of non-hazardous waste
V22	Regeneration of mineral oils	T13	Disposal of hazardous waste
V23	Incineration of sanitary waste	T21	Incineration of non-halogenated waste
V24	Recycling of organic substances not used as solvents	T22	Incineration of halogenated waste
V41	Recycling and recovery of metals or metal compounds	T24	Evaporation treatment
V42	Regeneration of other inorganic materials	T31	Physico-chemical and biological treatment
V44	Recovery of batteries and accumulators	T32	Specific treatment
V48	Catalyst recovery	T33	Stabilization
V61	Use as fuel		

ANNEX II. ZONES AND PROCESSES IN AN ATF

Table 11. Processes in each zone of the ATF

Receving and storage zone of ELV
ELV delivery
Issuance of the destruction certificate
Administrative discharge in the DGT
ELV storage
Decontamination zone
Battery removal
Fuel extraction
Engine, differential and gearbox oils extraction
Brake fluid extraction
Antifreeze and cooling fluid extraction
Extraction of fluids from the air-conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.
Removal of oil and fuel filters
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium
Removal of catalyst
Removal and/or neutralization of potentially explosive components (For instance: airbags)
Waste storage zone
Fluid storage
Storage of solid components
Sewage collection and treatment system
Dismantling zone
Removal of components and pieces intended for reuse
Storage of components zone
Storage of components and pieces intended for reuse
Storage of ELV decontaminated zone
ELV decontamined storage
Compaction zone
ELV compaction
Shredding and postshredding zone
Fragmentation
Postfragmentation

ANNEX III. SHREDDING AND POSTSHREDDING

The "fragmented" fraction will be sent directly to the steel industry for its foundry and forsubsequent development of new products. Concerning the management of light fraction, at present, the most widespread practice is to disposal it into landfill. However, alternatives have also been implemented for energy recovery as an alternative fuel and techniques for recycling are being developed and innovated. As for the heavy fraction, it must be either processed in the own fragmentation plant or sent to another more specialized plant that allows the separation of the non-ferrous metals from the other materials (postfragmentation).

In postfragmentation installations the heavy fraction comes through different segregation processes (screenings, induction currents, densimetric tables, optical systems, etc.) to obtain on the one hand, the different non-ferrous metals (aluminum, copper, etc.) which will be sent to their steel plants for recycling and on the other hand, other fractions of non-metallic materials (glass, plastic, textile, etc.) that can be recycled, energy valorized or destined to another type of management depending on its characteristics.

The composition of a typical vehicle (without fuel) is as follow in Figure 24.

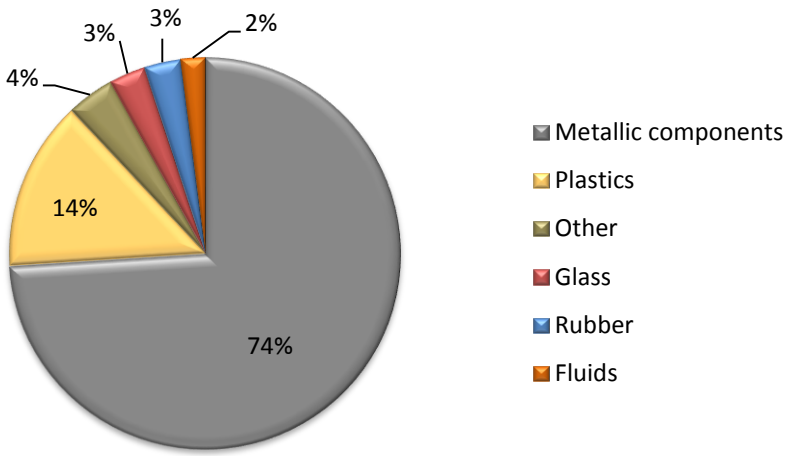


Figure 24. Composition of a type vehicle. Source: UCAV (2015)

It can be seen how most of the ELV are metallic components which must be dismantled to be reused or recovered to extend the life-cycle.

ANNEX IV. CHECKLIST

Table 12. Checklist

	Operation - Conditions				Comments
	Excelent	Good	Improvable	Does not have	
Receving and storage zone of ELV					
Entry of the ATF					
ELV storage					
Storage methodology					
Impermeable pavement					
Spillage collection facilities, decanters and cleanser-degeasers					
Decontamination zone					
Batery removal					
Fuel extraction					
Engine, differential and gearbox oils extraction					
Brake fluid extraction					
Antifreeze and cooling fluid extraction					
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.					
Removal of oil and fuel filters					
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium					
Removal of catalyst					
Removal and/or neutralization of potentially explosive components (Airbags)					
Covered area					
Impermeable pavement					
Spillage collection facilities, decanters and cleanser-degeasers					
Waste storage zone					
Fluid storage					
Storage of solid components					
Sewage collection and treatment system					
Covered area (Oil*)					
Impermeable pavement (Oil*)					
Batteries container					
For the above, possibility of neutralization in case of accident					
Filters container					
PCB y PCT capacitators container					
Suitable containers for the different fluids					
Tyre storage areas					
Fire protection and prevention of arising risks from tyre storage					
Dismantling zone					
Removal of components and pieces intended for reuse					
Storage of components zone					
Storage of components and pieces intended for reuse					
Storage of ELV decontaminated zone					
ELV decontamined storage					
Enclosed or fenced area in all its perimeter					
Compacted and conditioned soil					
Surface water collection system					
Compactation zone					
ELV compactation					
ATF in general					
Pavement and soil					
Wastewater treatment system					
Cover of the facility					
Machinery used to relocate ELV inside the facility					
Water collection and treatment equipment, including rainwater in non-covered areas					
Further comments about the ATF					

ANNEX V. DIAGNOSIS OF ATF ASSESSED

Table 13. Checklist ATF 1

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF			X		A lot of ELV stored in stack which make very difficult the entrancy
ELV storage			X		
Storage methodology			X		Stacked
Impermeable pavement			X		Concrete
Spillage collection facilities, decanters and cleanser-degeasers			X		Facility with pendent. It would be needed more drains for water collection
Decontamination zone					
Batery removal			X		ELV are being decontaminated outside the covered zone designed for it. That is why this process is questioned. In addition, the remove of fluids is done by gravity on a reused plastic container.
Fuel extraction			X		
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction			X		
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.			X		
Removal of oil and fuel filters			X		
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium			X		
Removal of catalyst			X		
Removal and/or neutralization of potentially explosive components (Airbags)			X		
Covered area			X		
Impermeable pavement			X		
Spillage collection facilities, decanters and cleanser-degeasers			X		
Waste storage zone					
Fluid storage			X		The storage of fluids is done in a non-profesional way. There are not enough containers for each fluid and solid waste is dispersed
Storage of solid components			X		
Sewage collection and treatment system			X		
Covered area (Oil*)			X		
Impermeable pavement (Oil*)			X		Concrete
Batteries container			X		
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container				X	Not seen
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids				X	Neither appropriate nor sufficient
Tyre storage areas				X	
Fire protection and prevention of arising risks from tyre storage				X	Fire sprinklers and extinguishers
Dismantling zone					
Removal of components and pieces intended for reuse			X		Se realiza al aire libre, en el mismo sitio donde se descontamina
Storage of components zone					
Storage of components and pieces intended for reuse		X			Almacen con numerosas piezas ordenadas en estanterías
Storage of ELV decontaminated zone					
ELV decontamined storage			X		Too many ELV
Enclosed or fenced area in all its perimeter			X		Metalic work fencing
Compacted and conditioned soil			X		
Surface water collection system			X		
Compaction zone					
ELV compactation				X	
ATF in general					
Pavement and soil			X		
Wastewater treatment system			X		
Cover of the facility			X		
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas			X		
Further comments about the ATF					
There are little collectors for dumpings and spills. In addition, the ATF is built with pendent and in the entrancy there are not collector for rainwater episodes.					

Table 14. Checklist ATF 2

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF		X			
ELV storage		X			
Storage methodology		X			
Impermeable pavement		X			
Spillage collection facilities, decanters and cleanser-degeasers			X		Few collection pits
Decontamination zone					
Batery removal		X			
Fuel extraction			X		Fuel reused by employees
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction			X		
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.			X		
Removal of oil and fuel filters			X		
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium				X	Not seen
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)				X	Not seen
Covered area			X		Intermediate covered zone joining the decontamination with the dismantling
Impermeable pavement			X		Concrete with some cracks
Spillage collection facilities, decanters and cleanser-degeasers			X		Spills are collected with sepiolite / rags
Waste storage zone					
Fluid storage			X		Storage in containers with retention systems (surroundings with bad appearance)
Storage of solid components			X		Extracted components stored and labeled correctly, but on compacted and unpaved
Sewage collection and treatment system			X		
Covered area (Oil*)			X		
Impermeable pavement (Oil*)			X		
Batteries container		X			
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container			X		Not used
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids			X		Spilled liquid is observed, as well as in the surroundings
Tyre storage areas		X			
Fire protection and prevention of arising risks from tyre storage		X			Fire protection system throughout the facility
Dismantling zone					
Removal of components and pieces intended for reuse		X			
Storage of components zone					
Storage of components and pieces intended for reuse		X			There is a bit of clutter, in the vehicle storage area are some wheels and parts
Storage of ELV decontaminated zone					
ELV decontamined storage		X			Compacted but not paved
Enclosed or fenced area in all its perimeter			X		Metalic fencing
Compacted and conditioned soil		X			
Surface water collection system			X		Poor rinwater collection system (little visibility)
Compaction zone					
ELV compactation				X	
ATF in general					
Pavement and soil			X		
Wastewater treatment system			X		
Cover of the facility			X		
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas			X		
Further comments about the ATF					
The installation is located in an industrial polygon located on a mountain and next to a little flowing river. The installation is in slope and the collection of the rainwater is made by pits and sent to a decanter - separator of HC. In addition can be seen numerous fissures in the concrete ground that can be considered as possible contamination focus. There are usually few storm drainage and spill collection.					

Table 15. Checklist ATF 3

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF		X			
ELV storage		X			
Storage methodology		X			
Impermeable pavement		X			Concrete
Spillage collection facilities, decanters and cleanser-degeasers			X		Pits for rainwater collection. The facility is in a mountain near a river
Decontamination zone					
Batery removal		X			Containers over pallets
Fuel extraction			X		By gravity, the extracted fuel is reused for internal use
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction				X	
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.			X		
Removal of oil and fuel filters			X		
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium				X	Not seen
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)				X	Not seen
Covered area		X			
Impermeable pavement		X			Concrete + epoxi resin (poor)
Spillage collection facilities, decanters and cleanser-degeasers		X			Sepiolite
Waste storage zone					
Fluid storage			X		No pipes, filled with a bomb
Storage of solid components			X		
Sewage collection and treatment system		X			
Covered area (Oil*)		X			
Impermeable pavement (Oil*)		X			
Batteries container		X			Stacked containers
For the above, possibility of neutralization in case of accident				X	
Filters container				X	Not seen
PCB y PCT capacitators container				X	
Suitable containers for the different fluids		X			With retention system but they are filled with a hose"
Tyre storage areas		X			
Fire protection and prevention of arising risks from tyre storage		X			
Dismantling zone					
Removal of components and pieces intended for reuse	X				
Storage of components zone					
Storage of components and pieces intended for reuse	X				
Storage of ELV decontaminated zone					
ELV decontamined storage		X			
Enclosed or fenced area in all its perimeter			X		Metalic fencing
Compacted and conditioned soil		X			Paved with concrete
Surface water collection system		X			
Compaction zone					
ELV compactation				X	No
ATF in general					
Pavement and soil		X			100% paved ground (poor conditions)
Wastewater treatment system		X			Decanter and HC separation
Cover of the facility	X				
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas		X			There should be more pits to collect contaminated water. No separative network and no reuse of rainwater.
Further comments about the ATF					
Fuel is reused for the internal fleet. Pieces are extracted depending on the value and the storage. Waste storage (solids and liquids) takes a neglected aspect. Solid waste is stored over pallets in some cases.					

Table 16. Checklist ATF 4

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF		X			
ELV storage			X		A bit saturated of vehicles
Storage methodology		X			
Impermeable pavement			X		Concrete (poor)
Spillage collection facilities, decanters and cleanser-degeasers			X		
Decontamination zone					
Batery removal		X			
Fuel extraction			X		All the liquid extraction is over a metalic surface which collect the possible spills (fairly used)
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction			X		
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.				X	Not seen
Removal of oil and fuel filters			X		
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium				X	
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)				X	Not seen
Covered area			X		
Impermeable pavement			X		
Spillage collection facilities, decanters and cleanser-degeasers			X		
Waste storage zone					
Fluid storage			X		
Storage of solid components			X		
Sewage collection and treatment system			X		
Covered area (Oil*)			X		
Impermeable pavement (Oil*)			X		
Batteries container			X		
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container				X	Not seen
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids		X			
Tyre storage areas		X			Movil coverage for tyres and engines (recovered pieces)
Fire protection and prevention of arising risks from tyre storage			X		
Dismantling zone					
Removal of components and pieces intended for reuse		X			
Storage of components zone					
Storage of components and pieces intended for reuse			X		
Storage of ELV decontaminated zone					
ELV decontamined storage			X		Saturated
Enclosed or fenced area in all its perimeter		X			Metalic fencing
Compacted and conditioned soil			X		
Surface water collection system			X		
Compaction zone					
ELV compactation				X	No
ATF in general					
Pavement and soil			X		Very poor due to the age
Wastewater treatment system			X		Decanter and HC separation
Cover of the facility			X		
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas			X		
Further comments about the ATF					
In the decontamination zone there is a stationary module that extracts 6 different fluids. Besides, in the part that is in contact with the floor possesses a grid to retain spills.					

Table 17. Checklist ATF 5

	Operation - Conditions				Comments
	Excelent	Good	Improvable	Does not have	
Receving and storage zone of ELV					
Entry of the ATF	X				Not covered
ELV storage	X				
Storage methodology	X				
Impermeable pavement	X				Concrete
Spillage collection facilities, decanters and cleanser-degeasers	X				Sloped soil with pits for collection
Decontamination zone					
Batery removal	X				
Fuel extraction		X			Two zones. The first one, where is removed through suction: antifreeze and cooling fluid, braje fluid and other oils which can be extracted from the top. In the other zone the ELV is elevated and there is removed: engine, differential, gearbox oils and fuels
Engine, differential and gearbox oils extraction		X			
Brake fluid extraction	X				
Antifreeze and cooling fluid extraction	X				
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.				X	
Removal of oil and fuel filters			X		Compressor machine for fuel filters located in soiled corner
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium	X				
Removal of catalyst	X				
Removal and/or neutralization of potentially explosive components (Airbags)				X	Airbags are not extracted
Covered area	X				
Impermeable pavement	X				Concrete
Spillage collection facilities, decanters and cleanser-degeasers				X	Spills are collected with rags
Waste storage zone					
Fluid storage	X				Avobe ground tanks with double layer. Great charge and discharge
Storage of solid components	X				
Sewage collection and treatment system	X				
Covered area (Oil*)	X				
Impermeable pavement (Oil*)	X				Concrete
Batteries container	X				
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container				X	Not seen
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids	X				Good identification. Fluid transport by pipeline
Tyre storage areas	X				
Fire protection and prevention of arising risks from tyre storage	X				Fire sprinklers and extinguishers
Dismantling zone					
Removal of components and pieces intended for reuse	X				Covered zone with concrete soil. Pieces are cleaned in a small treatment plant (Zero dumping)
Storage of components zone					
Storage of components and pieces intended for reuse	X				Automated, very good logistics.
Storage of ELV decontaminated zone					
ELV decontamined storage	X				
Enclosed or fenced area in all its perimeter		X			Fenced zone with a metalic enclosure
Compacted and conditioned soil	X				Undergroud layerof geotextile at 2 metres. Conditioned and packed ground
Surface water collection system	X				
Compactation zone					
ELV compactation	X				Leaks are collected by the machinery
ATF in general					
Pavement and soil	X				Concrete at the entry and covered zones
Wastewater treatment system	X				Separative network with 2 desanders + HC flotation
Cover of the facility	X				Rainwater collection to reuse in the fire protection system
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas		X			Without pit collectors in the covered areas
Further comments about the ATF					
This facility has a small petrol station for internal use, reuse of fuel. It also includes a pit for possible dumpings. Wastewater generated in cleaning spare pieces is treated in a physical-electrochemical system of purification in where the water is recycled in closed circuit (Zero dumping). Other liquids collected in the ATF (except the cleaning wastewater) has as its final destination 2 underground clarifiers working as desander and separator of HC. In addition, rainwater collected in the roof is stored for recovery.					

Table 18. Checklist ATF 6

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF			X		Some of the workers breaking the security rules
ELV storage		X			
Storage methodology		X			
Impermeable pavement		X			Concrete
Spillage collection facilities, decanters and cleanser-degeasers			X		
Decontamination zone					
Batery removal		X			
Fuel extraction			X		For fluid extraction there is a lift module without a grid for collection
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction			X		
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.			X		
Removal of oil and fuel filters		X			
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium				X	
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)				X	
Covered area		X			
Impermeable pavement		X			Concrete + epoxi resine
Spillage collection facilities, decanters and cleanser-degeasers				X	No collecting pits inside the decontamination zone. When there is a spill is used sepiolite
Waste storage zone					
Fluid storage			X		Individual aerial deposits with collection systems
Storage of solid components			X		
Sewage collection and treatment system			X		
Covered area (Oil*)		X			
Impermeable pavement (Oil*)		X			Concrete + epoxi resine
Batteries container			X		
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container			X		
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids			X		
Tyre storage areas				X	
Fire protection and prevention of arising risks from tyre storage				X	
Dismantling zone					
Removal of components and pieces intended for reuse				X	
Storage of components zone					
Storage of components and pieces intended for reuse				X	
Storage of ELV decontaminated zone					
ELV decontamined storage			X		
Enclosed or fenced area in all its perimeter		X			There is a wall along the facility. In shredding zone is quite high
Compacted and conditioned soil		X			Concrete
Surface water collection system			X		Pits for collection along the ATF
Compaction zone					
ELV compactation				X	No
ATF in general					
Pavement and soil		X			Mostly concrete, in some zones with epoxi
Wastewater treatment system			X		
Cover of the facility		X			
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas		X			
Further comments about the ATF					
ELV treatment entails a small part of the installation because it is a shredding facility. During the decontamination are not used electric installations so that sparks could be avoided. There is a small petrol station for internal reuse.					

Table 19. Checklist ATF 7

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF		X			
ELV storage			X		Limited space
Storage methodology		X			There are some in shelves
Impermeable pavement		X			
Spillage collection facilities, decanters and cleanser-degeasers		X			Facility with pronounced slope
Decontamination zone					
Batery removal		X			La descontaminación se realiza en un módulo que posee un elevador para el vehículo y varios sistemas de drenaje móviles de la marca SEDA (un poco desordenados). A su vez, este módulo incluye en la parte inferior una rejilla estanca de recogida de derrames. Se extraen en primer lugar: la batería, las ruedas y los fluidos del aire acondicionado. Posteriormente se retiran los aceites, el combustible y el catalizador.
Fuel extraction			X		
Engine, differential and gearbox oils extraction			X		
Brake fluid extraction			X		
Antifreeze and cooling fluid extraction			X		
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.			X		
Removal of oil and fuel filters			X		The machine does not work
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium				X	
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)				X	
Covered area		X			
Impermeable pavement		X			
Spillage collection facilities, decanters and cleanser-degeasers		X			
Waste storage zone					
Fluid storage			X		Containers with retention system, they are filled with a hose (poor)
Storage of solid components			X		
Sewage collection and treatment system			X		Dusty pits
Covered area (Oil*)		X			
Impermeable pavement (Oil*)		X			
Batteries container			X		There are 5 containers with batteries waiting to be managed.
For the above, possibility of neutralization in case of accident				X	
Filters container			X		Not widely used, there is a plastic bucket for collecting the liquid
PCB y PCT capacitators container				X	
Suitable containers for the different fluids			X		Depósitos con cubeto de contención común
Tyre storage areas				X	Directly to fragmentation
Fire protection and prevention of arising risks from tyre storage				X	
Dismantling zone					
Removal of components and pieces intended for reuse				X	They would like to recovery pieces in near future
Storage of components zone					
Storage of components and pieces intended for reuse				X	
Storage of ELV decontaminated zone					
ELV decontamined storage		X			
Enclosed or fenced area in all its perimeter			X		Metalic fencing
Compacted and conditioned soil		X			
Surface water collection system		X			
Compaction zone					
ELV compactation				X	No
ATF in general					
Pavement and soil		X			
Wastewater treatment system		X			The collection of wastewater is not very good
Cover of the facility		X			
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas			X		
Further comments about the ATF					
ELV treatment is a secundary activity. The facility is emplaced in a mountain with descendant slope up to the entrancy. In there are also collected motocycles, bikes and others. There is a fire-fighting network and a water deposit in case of fire.					

Table 20. Checklist ATF 8

	Operation - Conditions				Comments
	Excelent	Good	Poor	Does not have	
Receving and storage zone of ELV					
Entry of the ATF			X		
ELV storage			X		
Storage methodology			X		Limited space
Impermeable pavement		X			
Spillage collection facilities, decanters and cleanser-degeasers		x			
Decontamination zone					
Batery removal	X				Extraction of the fluids is correct in a mobile trainfor decontamination and dismantling. The wheels are extracted and the aluminium pieces go direclty to foundry, whereas the rubber of the NFU stores separately.
Fuel extraction		X			
Engine, differential and gearbox oils extraction		X			
Brake fluid extraction		X			
Antifreeze and cooling fluid extraction		X			
Extraction of fluids from the air conditioned system, the liquefied gas tank and any other dangerous fluid not necessary for the reuse of any element.		X			
Removal of oil and fuel filters		X			
Removal of components and materials that according to Annex I of Royal Decree 20/2017 must be marked and identified as containing lead, mercury, cadmium and / or hexavalent chromium		X			
Removal of catalyst		X			
Removal and/or neutralization of potentially explosive components (Airbags)		X			
Covered area		X			
Impermeable pavement		X			Concrete + epoxi resine (poor)
Spillage collection facilities, decanters and cleanser-degeasers	X				The behind part of the train has a grid for spill liquids during the operation
Waste storage zone					
Fluid storage		X			Deposits with collection systems
Storage of solid components		X			
Sewage collection and treatment system				X	
Covered area (Oil*)		X			
Impermeable pavement (Oil*)		X			
Batteries container		X			
For the above, possibility of neutralization in case of accident				X	Not seen
Filters container				X	Not seen
PCB y PCT capacitators container				X	Not seen
Suitable containers for the different fluids		X			
Tyre storage areas			X		There are NFU distributed in the installation
Fire protection and prevention of arising risks from tyre storage		X			
Dismantling zone					
Removal of components and pieces intended for reuse				X	
Storage of components zone					
Storage of components and pieces intended for reuse				X	
Storage of ELV decontaminated zone					
ELV decontamined storage			X		
Enclosed or fenced area in all its perimeter		X			
Compacted and conditioned soil			X		
Surface water collection system		X			
Compaction zone					
ELV compactation			X		Mobile compactator. There is spilled a lot of liquid during this operation
ATF in general					
Pavement and soil			X		Poor
Wastewater treatment system		X			
Cover of the facility			X		Some places are not covered
Machinery used to relocate ELV inside the facility	X				Lifting pallets machine
Water collection and treatment equipment, including rainwater in non-covered areas		X			Separative network
Further comments about the ATF					
Most of the ELV can not be recovered because of an specific contract with the owner, they have to be destroyed at all.					

ANNEX VI. DAMAGE QUANTIFICATION

Table 21. Considerations to evaluate ATF type 1

Materials	Risk phrases	State of aggregation	Quantity (kg)
Gasoil ELV	H351, H304/H371, EUH066, H411	Solid	7,000,000
Gasoline ELV	H224/H242, H350, H315, H304/H371, EUH066, H411	Solid	7,000,000
Gasoil	H351, H304/H371, EUH066, H411	Liquid	9,800,000

Products	There are no hazardous products

Waste	LER code	Type of waste	State of aggregation	Quantity (kg)	Max. time of storage (months)
Gasoline	130702	Hazardous	Liquid	3,300	<6
Gasoline	130701	Hazardous	Liquid	3,300	<6
Oils	130205	Hazardous	Liquid	28,700	<6
Batteries	160601	Hazardous	Solid	61,000	<6
Catalysts	160801	Non-hazardous	Solid	7,300	>6
Out of use tyres	160103	Non-hazardous	Solid	90,300	>6
Decontamined and compacted ELV	160106	Non-hazardous	Solid	1,560,000	>6
Oil filters	160107	Hazardous	Solid	4,800	<6
Brake fluid	160113	Hazardous	Liquid	2,500	<6
Antifreezer	160114	Hazardous	Liquid	7,900	<6
Oiled water from hydrocarbon separator	130507	Hazardous	Liquid	91,300	<6
Hydrocarbon separator sewage	130502	Hazardous	Pasty	36,400	<6
Absorbents: rags/sepiolite	150202	Hazardous	Solid	34,000	<6
Ordinary waste	200301	Non-hazardous	Solid	144,700	>6

Historical activity	First activity	Age of the fist activity (years)
ATF type 1	Yes	17

Surface storage	Area (m^2)	Paving	Pavement state	Facility state	Covered	Rainwater network	Drainage network	Containment system	Emergency procedure
Contaminated ELV	181	Concrete	Regular	Good	No	Yes	No	No	Yes
Decontaminated ELV	27,900	Asphalt	Good	Good	No	Yes	No	No	Yes
Solid and liquid waste	350	Concrete	Good	Good	Yes	Yes	No	Yes	Yes
Out of use tyres	960	Concrete	Good	Good	Yes	Yes	No	No	Yes
Spare pieces and parts	5,300	Concrete	Good	Good	Yes	Yes	No	No	Yes

Surface deposits	Type of wall	Wall material	Wall protection	Volume (m^3)	Age (years)	Containment system	Leak collection
Gasoline deposit	Simple	Steel	Pasive	2	17	No	Si
Gasoil deposit	Simple	Steel	Pasive	2	17	No	Si

Underground deposits	Type of wall	Wall material	Wall protection	Volume (m^3)	Age (years)	Leak collection	Tightness testing
Gasoil	Double	Steel	Active	30	17	Yes	No

Processes	Area (m^2)	Process type 1	Process type 2	Process type 3	Containment system	Emergency procedure
ELV decontamination	700	Close	Discontinuous	Manual	Type 2	Yes
ELV dismantling	900	Close	Discontinuous	Manual	Type 2	Yes
Water treatment (Hydrocarbon separator)	40	Close	Discontinuous	Automatic	Type 2	Yes
ELV compaction	60	Open	Discontinuous	Manual	Type 2	Yes
Petrol station	40	Open	Discontinuous	Manual	Type 2	Yes

ANNEX VII. VULNERABILITY QUANTIFICATION

1. Natural heritage

In this section are included the natural heritage layers available at QGIS. Excluding Natura 2000 Network and Special Protection of Natural because they are contained at PEIN.

- PEIN
- Avifauna protection zones
- Areas of *flora and fauna* concern
- Geological heritage

2. Water

There are two groups: Surface water and ground water (Figure 22). Following the criteria of the Geological and Mining Institute of Spain (IGME) it is only considered the water within a radius of 5 km, because longer distances are not significant enough.

Surface water include: rivers, lakes and reservoirs.

Table 22. Classification of water and its risk levels

Surface water	Ground water
Include	
Rivers	Higher
Lakes	Middle
Reservoirs	Lower
Risk levels	
High (x < 1 km)	High
Medium (3 km > x > 1 km)	Medium
Low (x > 3 km)	Low

3. Permeability

Risk levels are set per the coefficient of permeability (k) obtained from Table 23. The levels of risk are:

Risk levels
High (k > 1)
Medium (1 > k > 10^{-4})
Low (10^{-4} > k)

Table 23. Aquifers Typology.

Source: Custodio,E., Llamas,M.R. *Underground Hidrology* (1976)

Permeability (m/day)	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1	10	10^{2}	10^{3}	10^{4}
Qualification	Waterproof		Low permeability		Somewhat permeable		Permeable			Very permeable	
Aquifer qualification	*Acuícludo*		*Acuitardo*		Poor aquifer		Aquifer from regular to good			Excellent aquifer	
Type of material	Compact clay Slate Granite		Sandy limo Silt Silty clay		Fine sand Silty sand Fractured limestone		Clean sand Gravel and sand Fine sand			Clean gravel	

4. Average annual rainfall

It considers the annual average of precipitation (P) provided by the *panual_shp* layer, which was downloaded from the website of the Department of Territory and Sustainability.

The average precipitation throughout Catalonia is approximately 600 mm/year. Based on this criteria and following set ranges were determined risk levels. The rainiest zones were above 1000 mm/year and driest below 500 mm/year. Most of the Catalan territory had values between 500 and 800 mm/year.

Risk levels
High (P > 1,000)
Medium (1,000 > P > 500)
Low (500 > P)

5. Slope

It is not available at QGIS but it has been used the software *gvSIG*, transforming grid regions MDT25 of Catalonia. With this analysis is possible to obtain information in any point, although it is necessary to analyse each area (quadrant grid) independently.

Risk levels
p > 40%
40% > p > 20%
20% > p > 10%
10% > p

6. Municipalities distance

It is considered the distance to the nearest town (higher population density per m^2, depending on layer *nucleo_pob* at MAGRAMA). The distance is calculated based on the geographical location (X and Y coordinates) to the town center, always following a straight line.

Risk levels
High (x < 1 km)
Medium (3 km > x > 1 km)
Low (x > 3 km)

7. Municipalities inhabitants

It is considered the number of inhabitants in each municipality. The layer available in QGIS does not provide information on the number of inhabitants, so it is necessary to establish a relationship (using the tool *JOIN QGIS*) between the municipalities and the QGIS.

Risk levels
High (h > 50,000)
Medium (50,000 > h > 5,000)
Low (5,000 > h)

ANNEX VIII. VULNERABILITY RESULTS

Table 24. Vulnerability evaluation results

ATF	Natural heritage	Surface water	Ground water	Permeability	Average annual rainfall	Slope	Municipalities distance	Municipalities inhabitants	TOTAL
1	960	800	2,400	270	1,200	50	2,400	270	**8,350**
2	1,440	800	800	2,400	1,200	170	2,400	270	**9,480**
3	960	800	800	270	1,200	50	2,400	270	**6,750**
4	1,440	2,400	2,400	2,400	1,200	50	2,400	270	**12,560**
5	480	2,400	2,400	2,400	1,200	50	2,400	270	**11,600**
6	480	2,400	2,400	2,400	1,200	50	800	800	**10,530**
7	960	2,400	2,400	270	1,200	170	2,400	270	**10,070**
8	0	2,400	2,400	2,400	1,200	50	2,400	270	**11,120**

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