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SARGA

PILOT PROJECT TO EVALUATE AND ADDRESS THE PRESENCE OF LINDANE AND HCH O PORRIÑO SITE - SPAIN

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1. Site characterization
2. Industrial history and lindane production
3. Actions carried out
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5. Conclusions



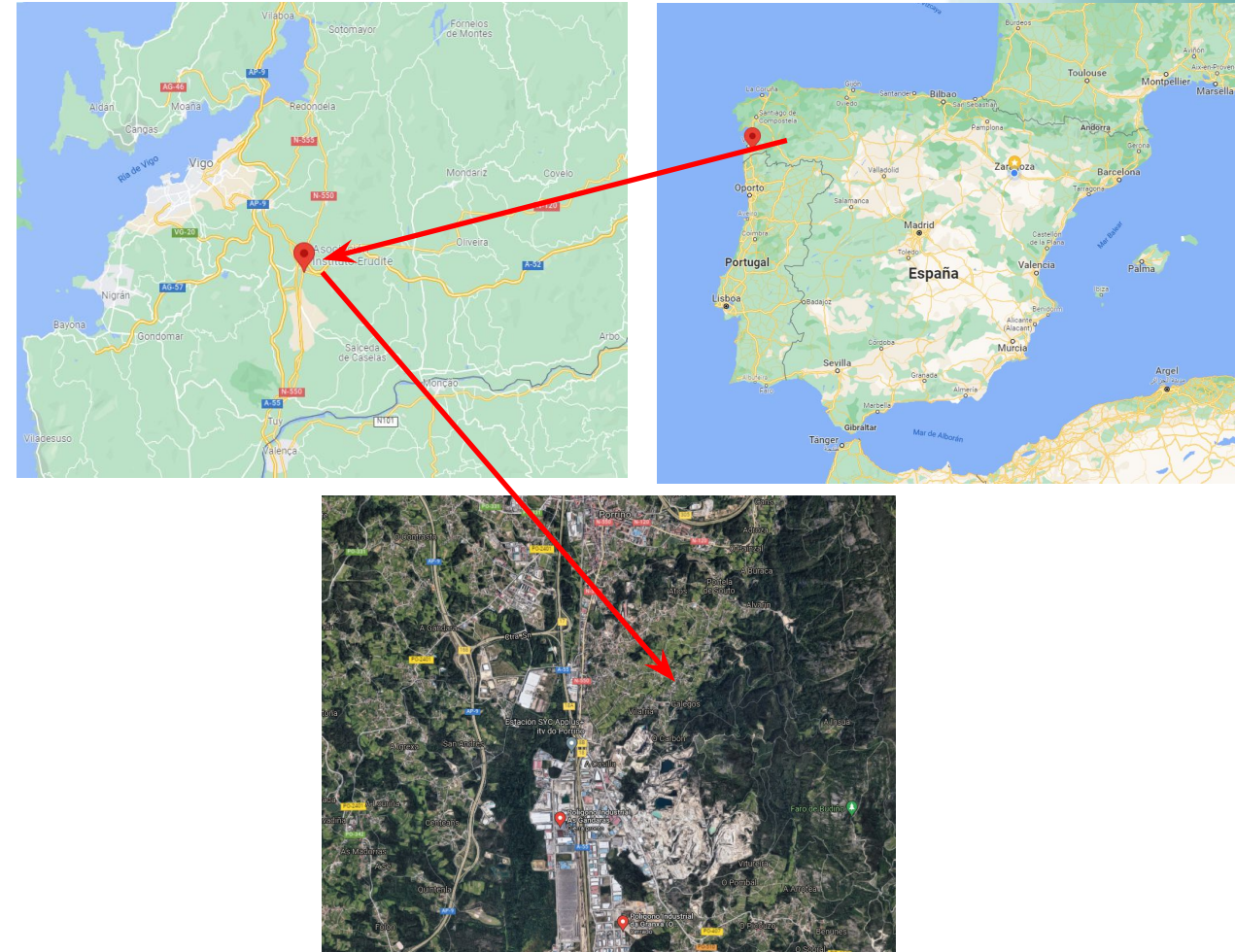
1. Site characterization

- Geographical situation
- Geology and lithological description
- The Louro river
- Meteorology and hydrology

1. SITE CHARACTERIZATION

The study area is located in the Northwest of Spain, in the Southwest of the Autonomous Community of Galicia, province of Pontevedra, and at an average height of 109 meters above sea level.

The City Council of O Porriño, located about 14 km from Vigo, is made up of 114 inhabited nuclei distributed in 8 parishes. It has a wide industrial tradition, and that has involved the construction of various industrial estates dedicated to the chemical, pharmaceutical, wood and ornamental stone mining industries



LOURO RIVER

The Louro river is born at an altitude of 400 meters in the municipality of Pazos de Borbén, in the Sierra do Galleiro with more than 700 m of altitude, and flows into the Miño river in the town of Pazos de Reis, in the municipality of Tui. Its total length is 30 km and its basin covers about 174 km² of surface. Along its route it crosses the towns of Pazos de Borbén, Mos, Redondela, Porriño and Tui.

The Louro river basin is a fluvial valley of tectonic origin, oriented N-S and flanked to the W by the Vigo-Tuy metamorphic Complex, and to the E by the Igneous Complex of Porriño Granites (IGME, 1981).

Its average flow, measured at the 1646 gauging station in O Porriño, is $1.341 \text{ m}^3/\text{s}$.

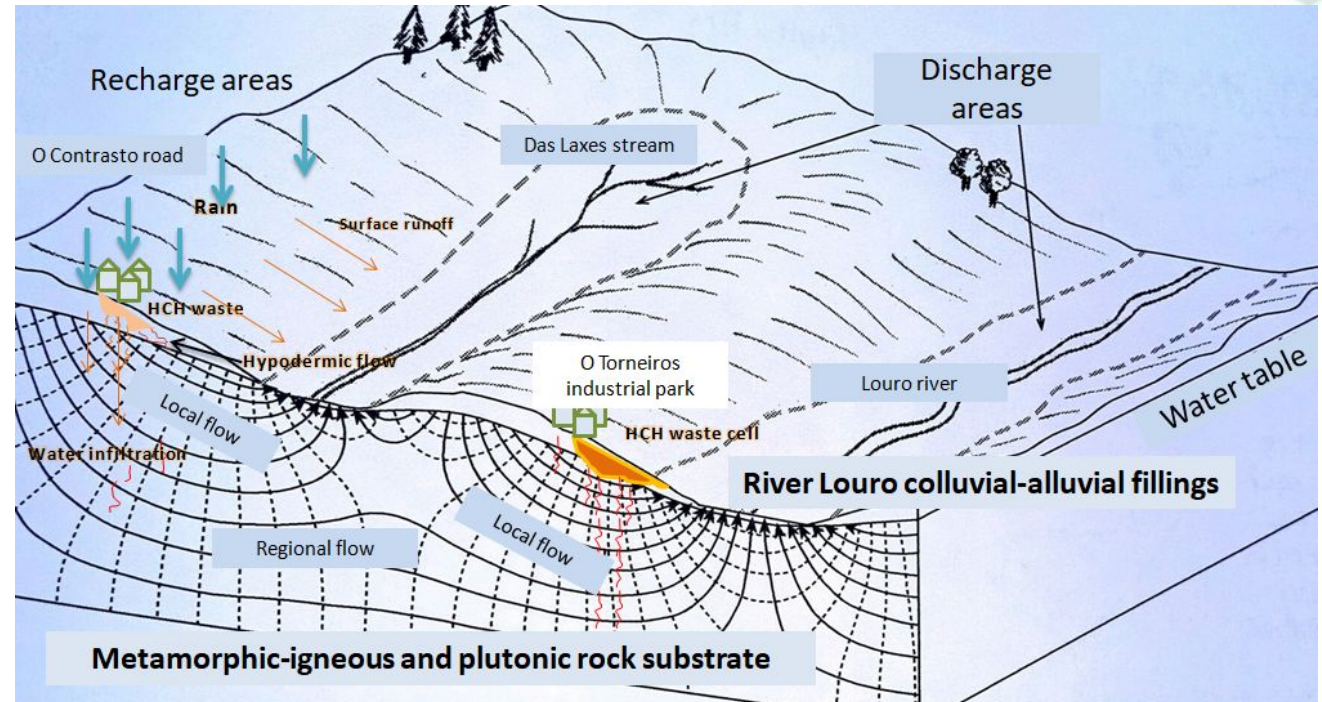


GeoPortal. Ministry of Agriculture, Fisheries and Food of Spain.

METEOROLOGY AND HYDROLOGY

O Porriño should be considered a classic Mediterranean climate type zone. Rainfall is regular throughout the year (1000 - 1500 mm), with November with rainfall around 217 mm being the wettest month and July, with averages around 40 mm, as the driest month. The thermal oscillation is smooth, between 8.8 and 15.5 °C on average.

Regarding the total average rainfall, 60% is runoff and 40% infiltration. The importance and connection of local and regional flows must be studied.



2. Industrial history and lindane production



- O Porriño industrial evolution
- Lindane production
- Identified discharge points

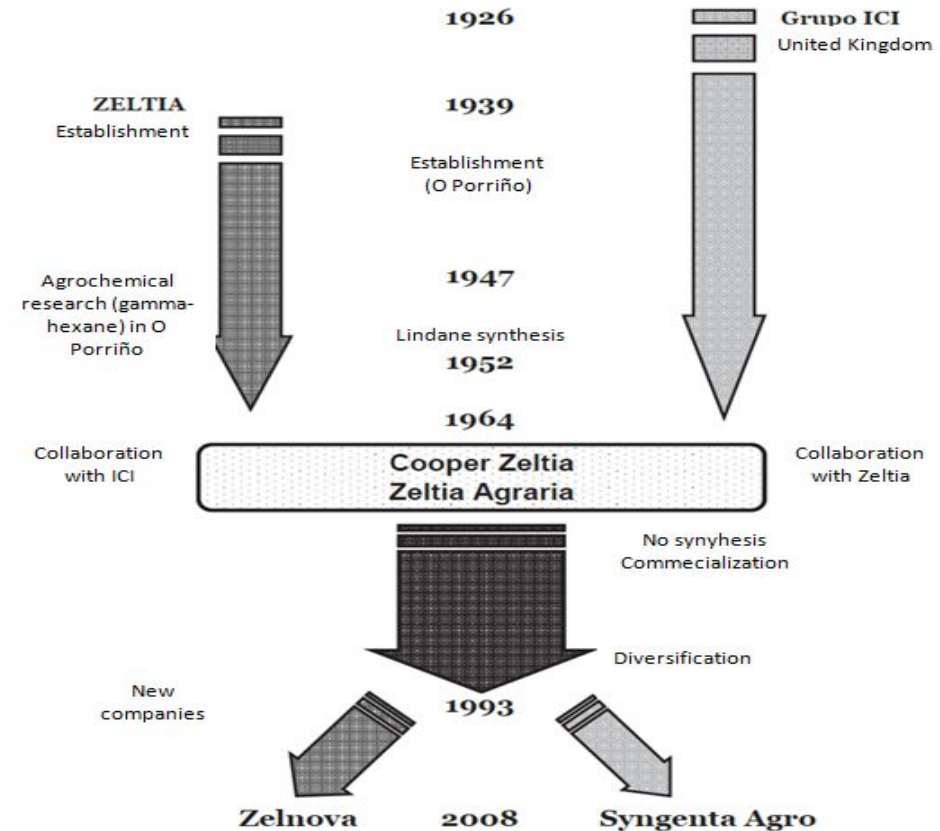
2. INDUSTRIAL HISTORY AND LINDANE PRODUCTION

Since the beginning of pesticide research and development in the 1940s, Galicia has played an important role. Different international and national chemical industries centralized their activity in the Polígono Industrial de Torneiros, O Porriño (Pontevedra).

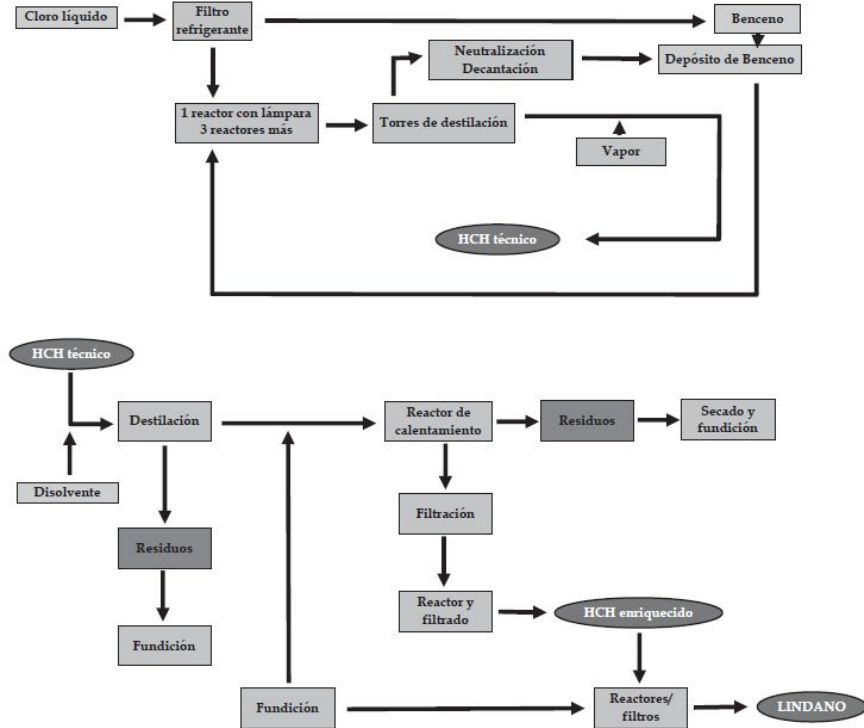
The English company Imperial Chemical Industries (ICI) pioneered various investigations, soon promoting expansion into Spain (through ICI Spain S.A.).

On the other hand, there has been a local initiative, represented by the company Zeltia S.A., founded on August 3, 1939, in Vigo.

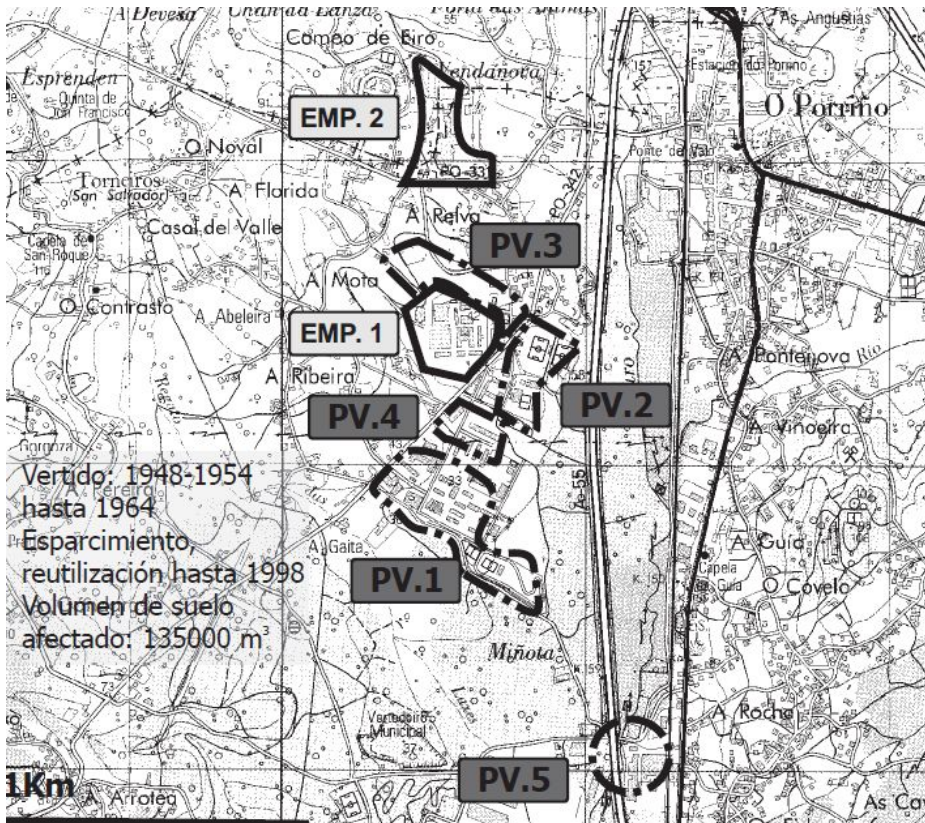
Since the 1950s, the history of these two great companies has been mixed (collaboration / merger / creation of new companies).



Extracted from "Hexachlorocyclohexane in Galicia: Some data on production, use and contamination"



- In approximately 1947, Zeltia began the synthesis and formulation of agrochemical products. One of the main products was lindane, then called "Gamma-hexane"
- In 1952, Zeltia undertook a renewal of the technical team, expanding the range of products, and initiating international collaboration with ICI
- In 1964 Zeltia and ICI create new companies, reorienting their activities. It is assumed that it is at this time when the synthesis of agrochemical compounds was paralyzed, leaving the formulation and packaging as the only activity.
- Until 1964, approximately 1000 tons of residues from the production of lindane were dumped, mainly in the industrial zone of Torneiros in the municipality of O Porriño (Pontevedra), although later the residues were dispersed over the years due to the leveling works of the area associated with the construction of a highway and urban buildings.



Identified discharge points

In the "Technical analysis based on the results of the investigation of HCH waste dumping points" carried out by the company Eptisa in 1999, two contaminated industrial sites and five dumping points were detected:

EMP1: Zelnova, S.A., CZV, S.L., Cooper Zeltia Veterinaria, S.A. and Glaxo Wellcome Biofarma, S.A.

EMP2: Zéneca Argo and Zéneca Farma

PV1: Torneiros housing estate and cycle touring circuit

PV2: Club Porriño football stadium

PV3: North and East zone of the factory

PV4: San Rosendo Parish and Technology Center

PV5: Industrial zone between the railroad and the highway

Subsequent investigations demonstrated the existence

3. Actions carried out



- Torneiros security cell
- Actions carried out at industrial sites
- O Contrasto road investigation
- Ponteareas investigation

3. Actions carried out

Torneiros security cell



Perimeter of the security cell. Extracted from "Study of the security cell of the Torneiros industrial estate in O Porriño (Pontevedra)", Geocisa 2020.

- From the end of the lindane production (1964) and until the construction of the housing estate (1970s), the area under study was used as a municipal waste dump, so the materials affected with HCH were covered by other types of waste.
- During the construction of the housing estate, excavations were made for the basements of these buildings and the fillings were moved in a southeasterly direction. Later, at the end of the nineties, the so-called cycle tourism circuit was built in the southern part of the plot and possibly on the historically accumulated waste.
- In March 1997, technicians from the Industrial Environment Laboratory of the Xunta de Galicia carried out an inspection in which high concentrations of the different isomers of hexachlorocyclohexane analyzed were detected and a risk analysis was carried out.
- A series of preventive measures were adopted aimed at protecting the population, such as the definitive closure of all existing wells in the area and the prohibition of the use of underground water, as well as the perimeter fencing of the affected lands and the closure of the circuit of cycling.

3. Actions carried out

Torneiros security cell

After the pertinent study of recovery alternatives, the construction of an on-site confinement cell was selected as the most technically and economically viable. Construction took place in two phases:

The first phase, carried out between October 1999 and March 2000, included the following tasks:

- Selective excavation of contaminated land. The more superficial soils, with HCH concentrations higher than 5 mg / kg (1,700 m³), were transported to a hazardous waste treatment plant. The rest of the excavated material (9,300 m³) was spread and compacted.
- Regeneration of the excavated area, which included filling the edge of the excavation (0.50 m thick) with clay and the rest with inert material. Superficially it was covered with a layer of gravel and the cycle touring circuit was replaced with bituminous pavement.

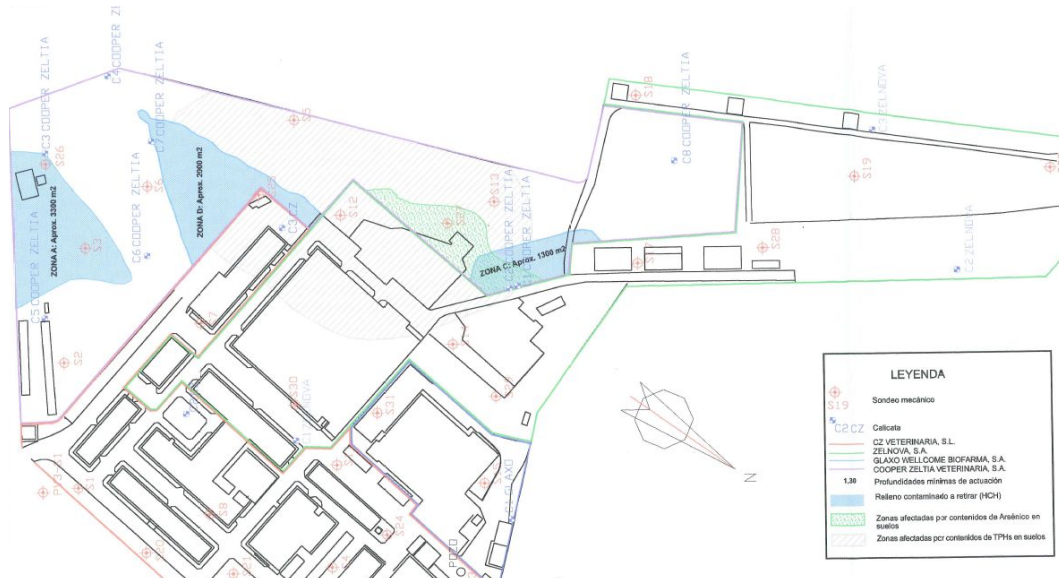
The second phase took place between June 2000 and December 2001, and included the following works:

- Perimeter screen to the area to be confined, built in situ by filling with a cement-bentonite (3-1) mixture. According to the available data, the final screen consists of a length of 800 m, a thickness of 60 cm and reached an average depth of 28.5 m.
- Multilayer surface sealing, consisting of the following layers: geotextile, waterproof barrier formed by a bentonite geocomposite, drainage layer made up of a draining geocomposite and final coverage of a thickness of 0.30 m of gravel and 1 m of topsoil.
- Construction of a perimeter canalization formed by a trapezoidal section.
- Restoration of the action area, landscaping and construction of a recreational area.

The current data do not allow to determine if the HCH concentrations detected downstream of the cell are the consequence of a potential contribution by the confined area or a mobilization of the pollution plume from external sources located upstream of the infrastructure.

3. Actions carried out

Actions carried out at industrial sites



Extracted from "Immediate actions in the factory of Cooper Zeltia Veterinaria, S.A.", Eptisa 2000.

- Various investigations have been carried out in the two industrial sites located in the urban area of O Porriño, detecting HCH contamination in water and soil in some of the samples analyzed.
- Some surface seals, drainage systems, excavations and replacements of soils and sealing of wells have been implemented.
- There is no evidence of the execution of all the immediate actions recommended in the different investigations, such as checking the state of the sanitation network and the periodic control to verify the effectiveness of the measures adopted.
- There is no documentation on the treatment given to the excavated soils or their deposit in an authorized landfill, or their improvement by means of solvent washing or on-site biodegradation, if this option has been chosen.

3. Actions carried out

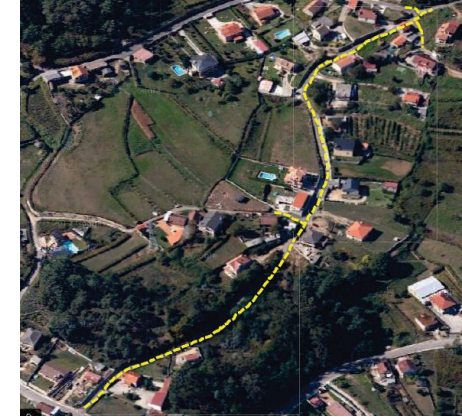
O Contrasto road investigation

The existence of indications of the presence of HCH compounds in surface and groundwater in the Pereira - O Contrasto area in O Porriño prompted the General Directorate of Environmental Quality and Climate Change to carry out an investigation of soil quality and groundwater in the last quarter of 2017.

The carrying out of the reconnaissance works in the area coincided with some works for the implantation of a sanitation network. The opening of trenches for these works allowed observing the existence of a more or less continuous level of a white material identified as a residue from the manufacture of lindane. The analytical results confirmed that the observed layer is a residue of high purity HCH and that in the soils sampled at the same point below this level (up to 2m deep) they present high concentrations of HCH.

The residue itself and the soils located below it present concentrations of alpha, beta and gamma HCH much higher than those established as Generic Reference Levels (over 100 times or more).

The absence of in situ treatment alternatives that allow satisfactorily eliminating the source of contamination due to the presence of HCH compound residues implies the need to propose ex situ treatment alternatives, consisting of the removal of the waste and affected soil. Said excavation must be carried out to the extent that the technical, environmental and economic conditions allow it.



Extracted from "Detailed analytical investigation of the roads in the O Contrasto area in O Porriño (Pontevedra)", Applus 2018.

3. Actions carried out

Ponteareas investigation



In the study area, construction waste was dumped from the excavation carried out during the execution of sanitation works (not identified) in the O Porriño Council. Subsequently, it was found that the materials contained residues from the production of lindane and were contaminated by various isomers of HCH.

The waste was removed and managed by a hazardous waste manager. The volume of material extracted greatly exceeded the volume of material dumped, and it has been investigated whether the removal has been effective and HCH remains are no longer present in the plot.

Eight manual pits were executed and soil and surface water analyzes were carried out. The concentration of HCH in soils exceeds the Generic Reference Levels for industrial use, and the surface waters do not meet the established quality objectives. No other action is planned.

Extracted from "Soil investigation in a quarry where soils with lindane were deposited in Ponteareas (Pontevedra)", Eptisa 2018.



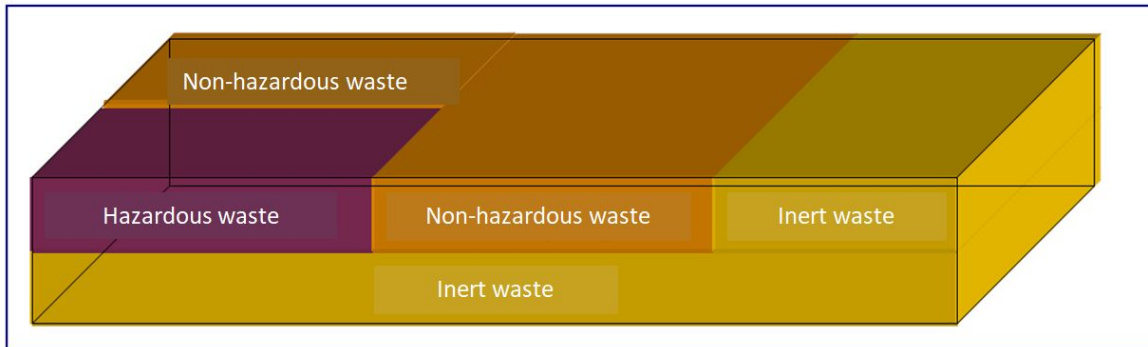
4. The Action Plan

- Suggestions for developing a selective excavation plan, Concellos of O Porriño and Mos – Spain
- Proposal for an Environmental Surveillance Plan in the HCH Cell Area in the Torneiros industrial park (O Porriño, Pontevedra)
- Study of the security cell in the Torneiros industrial park in O Porriño: Proposal of alternatives
- Proposal for the investigation of points with HCH manufacturing waste, Concellos of O Porriño and Mos – Spain
- Proposal for the elaboration and management of the data for the creation of an analytical monitoring “GIS”
- Approach to the needs for a Hydrogeological model of the Louro River Basin in the municipalities of Mos, O Porriño and Tui
- Launch of the Social Committees

4. The Action Plan

Suggestions for developing a selective excavation plan, Concellos of O Porriño and Mos – Spain

The purpose of this document is to establish a Selective Excavation Plan, which allows identifying possible sources of contamination until now unknown and thus avoiding the spread of contamination.



Control volumes with the different destinations (Excavation waste management guide. Government of Cantabria).

The circumstances in which it will be necessary to prepare a selective excavation plan are defined and its content is developed in detail.

The characterization of the materials to be excavated will preferably be carried out prior to the elaboration of the Plan. A mesh will be established whose size will depend on several factors (the homogeneity of the material, the volume of excavation, the depth set by the project, etc).

The control volume will be established based on the mesh, in order to define the destination of the materials. The sizing of the sampling will be based fundamentally on the existing previous information on the soil to be characterized.

The subjects responsible for the decontamination and recovery of contaminated soils are established in accordance with current legislation, and the financial aid offered by the Autonomous Community of Galicia is described.

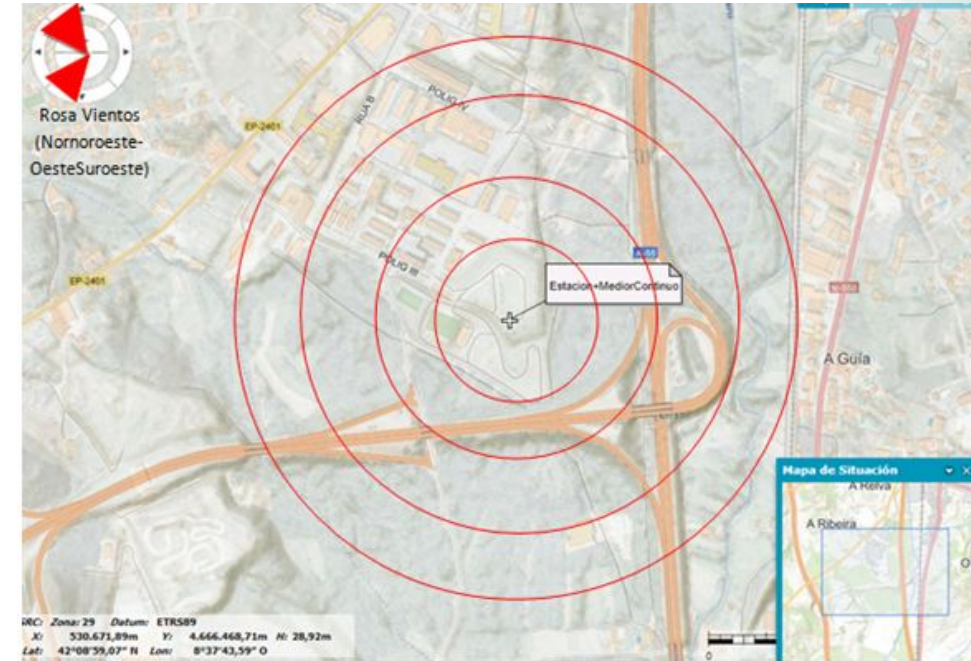
4. The Action Plan

Proposal for an Environmental Surveillance Plan (ESP) in the HCH Cell Area in the Torneiros industrial park (O Porriño, Pontevedra)

Based on the study of the available documentation, and considering the surveillance programs developed in the Bailín and Sardas dumps and the Inquinosa factory for the supervision of the remediation and decontamination tasks of the sites, an ESP of the HCH waste cell is proposed, with the final objective of assessing the status and evolution of the main pollutants and the associated consequences.

The content of the proposed Plan is made up of the following sections: Topography, Surface water, Groundwater, Soil and sediment quality (cleaning), Air quality assessment, Study of the ecological state of the Louro River and State of the infrastructure of the waste cell.

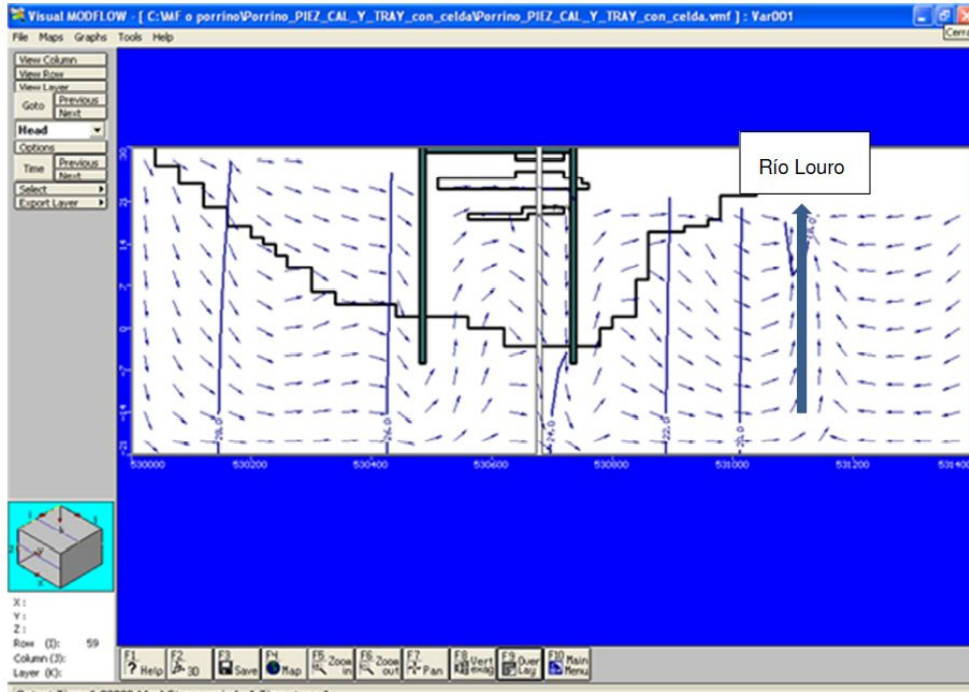
In each section its purpose is indicated, the number of points to be sampled, their location and the periodicity of the sampling, and an approximate assessment of the annual cost of its implementation and exploitation is made.



Placement of a continuous meter with a basic meteorological station in the center of the site to be controlled, for recording parameters and measuring particles in immission.
SARGA 2021.

4. The Action Plan

Study of the security cell in the Torneiros industrial park in O Porriño: Proposal of alternatives



Profile with isopieces and vectors of the hydrogeological trajectory in the area of the cell. The aquifer discharge is the Louro River. Extracted from "Modeling of hydrodynamic operation in the environment of the lindane manufacturing waste safety cell in O Porriño (Pontevedra)", Geocisa 2020.

The purpose of this document is to analyze the origin and current situation of the security cell in the O Torneiros industrial estate and to propose alternatives with a view to its remediation. For this, the location of the site, the investigations carried out, the infrastructure executed and its operation are described, and different alternatives are proposed to reduce the concentration of HCH in the cell.

As described before, an 800 m long and 28.5 m average depth bentonite cement screen was executed, together with a waterproof surface seal and perimeter drainage. The cell does not have a bottom seal. There are indications that the waters inside the cell are not totally confined, taking into account the similar evolution of the piezometric data obtained both inside and outside the cell.

It is proposed to carry out a study of the state of the confinement. Considering the possible results of the study and the current legislation, 10 remediation alternatives are proposed, resulting in thermal desorption being the most advantageous.

4. The Action Plan

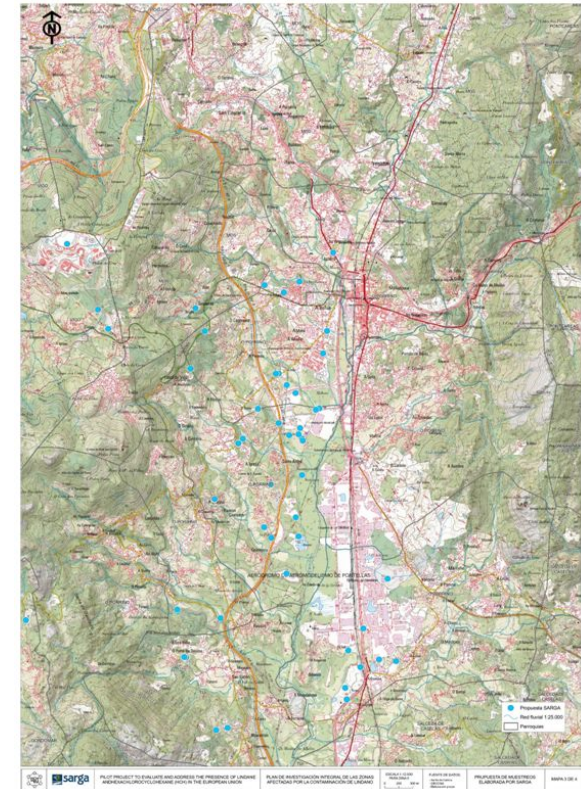
Proposal for the investigation of points with HCH manufacturing waste, Concellos of O Porriño and Mos – Spain

The purpose of this document is the analysis of the different research points carried out so far at the site and their associated documentation, the study of the environment for the planning of new inspection points and the definition of their location.

The values referenced in the revised documents exceed that indicated in the water quality regulations for the protection of surface and underground masses according to the Water Framework Directive, exceeding in some of the points the maximum admissible concentration indicated for priority substances of water quality.

The inclusion of 61 new research points is proposed, located according to the following criteria:

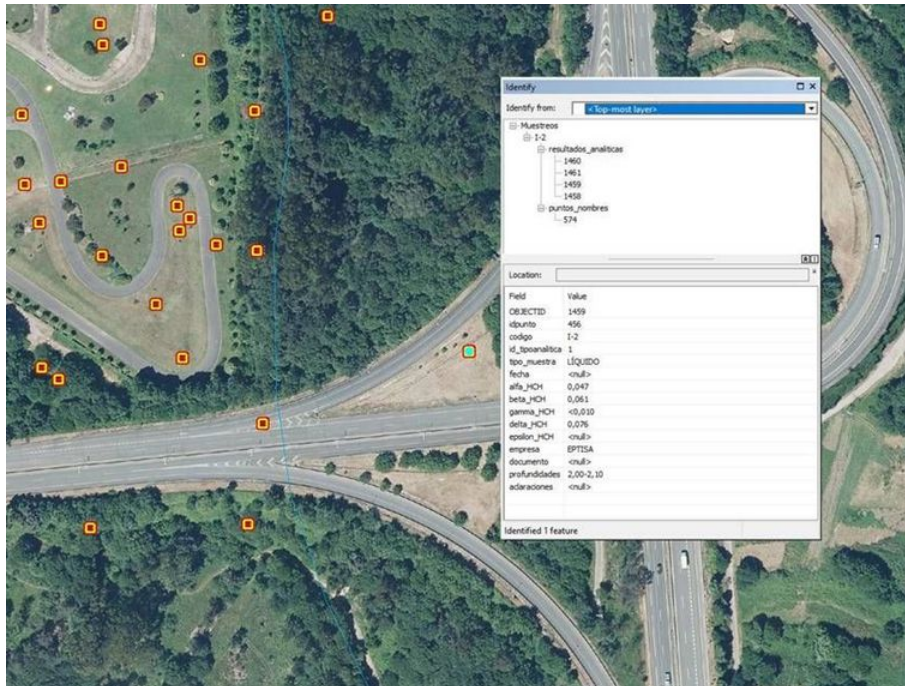
- Select trough zones, near ravines and / or rivers, in areas in whose proximity there are upstream affected zones or there may be landfills.
- Locate areas by comparing recent and historical aerial photographs, looking for evidence of landfills, expansions or earthmoving activity.
- Select industrial and urban areas with change and / or expansion in land use (from agricultural to urban).



Proposal for new research points. SARGA 2021.

4. The Action Plan

Proposal for the elaboration and management of the data for the creation of an analytical monitoring “GIS”



Location of a point (green) and its associated data. SARGA 2021

The purpose of this document is to organize the information, prepare georeferenced tables with all the analytical results of HCH isomers and facilitate their arrangement and handling, so that it allows subsequent analysis according to the interest of the Administration.

The Administration may, a posteriori, incorporate new data with firm and specific criteria that facilitate its updating, such as other pollutants of interest resulting from the degradation of HCH (organochlorines, etc), other contaminants of dangerous pesticides (found in some of the DDT samples and metabolites), metals, etc.

The developed application can also allow strategic decision-making regarding definitive remediation tasks, investigation of pollutants in agricultural soils, affected infrastructures and others, facilitating the inclusion of research data from new campaigns in addition to those incorporated herein.

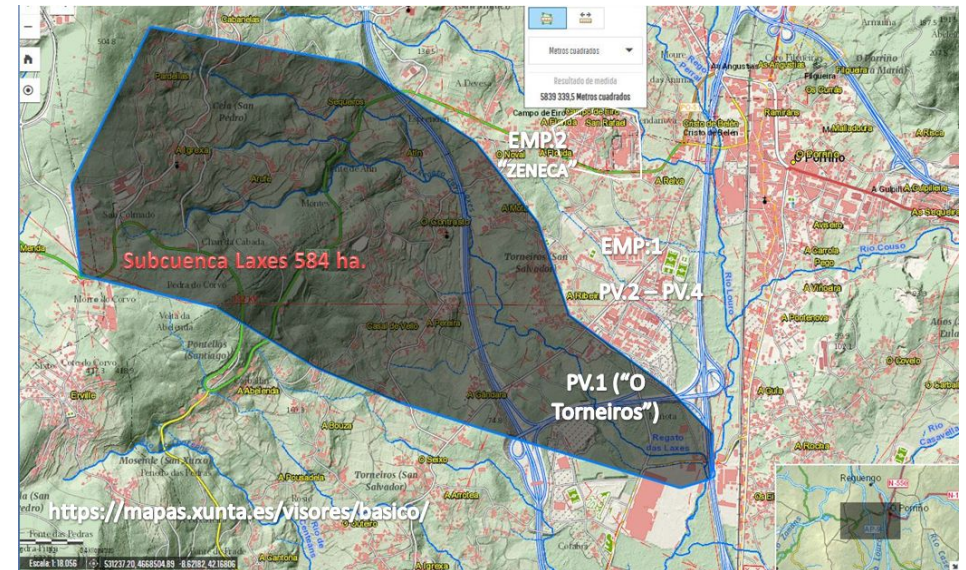
4. The Action Plan

Approach to the needs for a Hydrogeological model of the Louro River Basin in the municipalities of Mos, O Porriño and Tui

The document synthesizes the analysis of the information available provided by the Government of Galicia, in relation to the current situation that the Louro river basin presents due to the affectation of waste from manufacture of Lindane (γ -HCH) in various sites, in order to assess the available data and indicate the needs and complementary studies that would help to build a hydrogeological model of the affected areas.

For this, the locations, the investigations and available data and the infrastructures executed are synthetically described, being able to propose at the end other aspects and works that are considered necessary to obtain a basic conceptual model, revised regarding the studies already carried out in the areas, and obtaining an adequate hydrogeological model.

It is considered appropriate to continue with the work begun, but with a discretization of the sub-basins with respect to the main basin. The information analyzed and processed by sub-basins allows the development of discrete models, which can then be integrated into a more general model.



Example sketch of the Arroyo Laxes sub-basin on Galician Cartographic Viewer.

4. The Action Plan

Launch of the Social Committees

Support will be given to the competent administrations for the implementation of the different Committees, taking as a reference the scheme established by the Government of Aragón in the "Strategic Plan for the comprehensive fight against the contamination of waste generated by the manufacture of lindane in Aragón". The creation of the following Committees is proposed:

- Scientific Committee, made up of renowned experts who justify and improve the foundations and relevance of the established objectives and the measures carried out in the different fields of action.
- Institutional Committee, which ensures coordination between the different areas of competence related to the challenge and its solution.
- Social Committee, which articulates the participation of civil society and facilitates the flow of information as well as the communication process. It has representatives of environmental associations, labor unions, agricultural producer organizations, business associations and representatives of all parliamentary groups, to ensure the presence of all sensitivities.



5. Conclusions

During the industrial activity carried out in O Porriño (Pontevedra, Spain), it is estimated that around 1,000 tons of waste were produced from the manufacture of lindane.

Most of the waste was initially deposited in the municipal landfill, but subsequent works and the characteristics of the material led to its dissemination.

Important remediation actions have been executed (security cell) and numerous studies have been carried out in various areas, which have confirmed the extent of contamination.

The proposed actions are considered adequate to achieve an environmentally sustainable management of the site in the short / medium term, and to establish in the medium / long term an information system that allows advance decision-making.



THANK YOU FOR YOUR ATTENTION

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