



MINISTRY
FOR THE ECOLOGICAL TRANSITION
AND THE DEMOGRAPHIC CHALLENGE

SECRETARY OF STATE
FOR THE ENVIRONMENT

DIRECTORATE GENERAL FOR
ENVIRONMENTAL QUALITY AND ASSESSMENT

SECTION 12

USER'S GUIDE

– TRANSPORT MODULE –



TECHNICAL COMMISSION OF PREVENTION AND REMEDIATION OF ENVIRONMENTAL
DAMAGES

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12. TRANSPORT MODULE

Given the volume of information contained in the document '*SIRMA User's Guide*', and for the purpose of facilitating documentation management, this supplementary document has been prepared for the Transport Module.

12.1. TRANSPORT MODULE RATIONALE AND METHODOLOGY

The transport module aims to help operators calculate the probability of accident scenarios in the road transportation of goods. This module combines all the critical aspects necessary for constructing event trees, including identifying various accident scenarios and their associated probabilities.

The accident scenario probability calculation model is based on the methodology developed in the sector's MIRAT: MITERD has prepared road freight transport activities. This methodology is developed in section IX.4. Pages 80 to 104 of the document contain protocols for allocating probabilities to moving parts. Before calculating the equations in the MIRAT methodology, we conducted a thorough cartographic analysis to identify the resources along each road route and the likelihood of impacting them. The probability is mathematically expressed as the quotient of the length travelled over the territory with a certain characteristic (e.g. length over surface water) and a reference length (in this example, the total length of the route).

The Transport module proposes calculating routes between all municipalities within Spain's mainland.

12.2. ACCESS TO THE TRANSPORT MODULE

Access to the module for calculating the probability of accident scenarios for road freight transport must be through the SIRMA browser. To access the 'Event tree' menu button, go to the 'Transport Module' section located at the bottom left-hand side of the application screen in the MORA module.

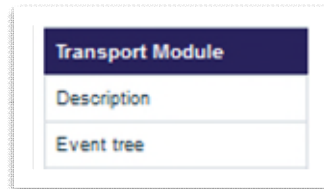


Figure 12.2-1. The 'Transport Module' can be accessed from the navigation panel. Source: SIRMA.

The description section provides a concise summary of the freight module's usefulness. Additionally, it provides hyperlinks to the MIRAT for road freight transport activities, the user manual of the SIRMA tool, and the annexes.

Description

The functionality developed through the "Transport Module" makes it easier for operators to calculate the probabilities of the environmental risk analyzes of the [MIRAT for road freight transport activities](#).

By entering the municipality of origin and destination of the transport itineraries and the type of vehicle load, the operators will obtain as a result the final list of accident scenarios generated in the corresponding transport itinerary and the probability of occurrence of each accident scenario.

For the selection of the reference transport itineraries that will be studied in the environmental risk analysis, the user is recommended to consult section "IX.1.2. Procedure for the selection of relevant itineraries of the operators activity as a whole" (Pages 61-72 of the MIRAT report).

In relation to the information on the vehicles load, the "Transport Module" requires the user to specify whether the vehicle is empty or transports some type of load and whether or not it is flammable. For this, it is recommended to consult the section "IX.1 Sources of danger" (Pages 57-58 of the MIRAT report).

With the above information, the "Transport Module" makes it possible to build and visualize the event tree associated with a specific itinerary, and to automate the calculation of the final probability of each accidental scenario as a result of the composition of the probability of the initiating event and the conditioning factors of its evolution, among them, the probability of affection to the different natural resources present in the transport itinerary.

Lastly, and to complete the construction of the event tree into which an initiating event ends, the operator must enter the amount of agent causing the damage associated with the initiating event and its evolution until reaching the amount that would finally be involved in each scenario. accidental. To this end, it is also recommended to consult the technical guidelines in section "IX.5. Protocols for calculating the amount of agent causing the damage" (Pages 104-112 of the MIRAT report).

With the information resulting from the "Transport Module" and the calculation of the volume released associated with each accident scenario, the operator can continue the analysis of environmental risks by calculating the environmental damage index (IDM) for each accident scenario, selecting the reference scenario, and calculate the cost of the primary repair measures thereof, through the Environmental Liability Offering Model (MORA).

Documentation

[User's guide](#)

[Annexes](#)

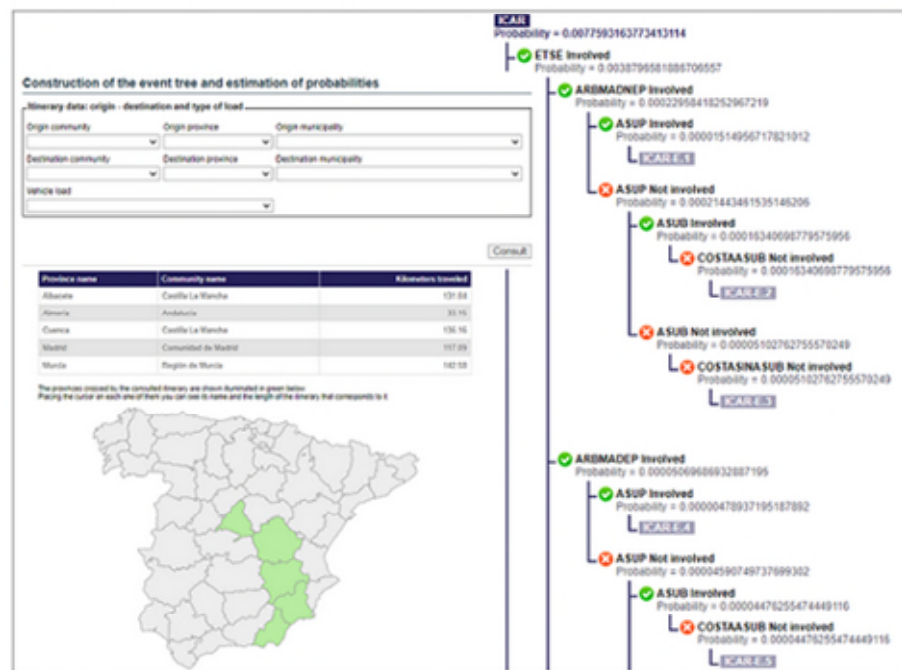


Figure 12.2-2. Description of the 'Transport Module' in SIRMA. Source: SIRMA

The information generated is not stored by this module. To display the event tree for a specific itinerary again on the screen, it will be necessary to repeat the request. It is possible to print a document containing the information generated for a specific route.

12.3. EVENT TREES

12.3.1. CONSTRUCTING AN EVENT TREE AND ESTIMATING PROBABILITIES

The transport module's goal is to determine the likelihood of various accident scenarios for a specific route between two municipalities. Each scenario may have implicit resources that could be affected.

To construct event trees for a goods transport route, the application requires the following fields to be completed:

- **Origin community.** Use this drop-down menu to select the Autonomous Community where the route begins.
- **Origin province.** To indicate the province where the journey begins, click on the drop-down menu. This option is available only after selecting the Autonomous Community.
- **Origin municipality.** From a drop-down list, you can select the municipality where the goods transport route being analysed begins. The municipality must belong to the indicated province and Autonomous Community.
- **Destination community.** Once again, you can use the drop-down menu to select the Autonomous Community where the route ends.
- **Destination province.** To indicate the province where the journey ends, simply click on the drop-down menu within the previously selected Autonomous Community.
- **Destination municipality.** Finally, you can select the municipality where the goods transport route being analysed ends. This municipality should belong to the indicated province and Autonomous Community.
- **Vehicle load.** The final drop-down on the screen enables the user to indicate if the vehicle transporting the goods is empty or loaded. If loaded, the user can specify if the load is flammable or not. This information will determine the type of event tree(s) that the application creates. The available choices are:
 - o **The vehicle is moving empty:** no cargo is being transported. Any potential accidents would likely involve the vehicle's fuel, such as fuel tank spillage or a vehicle fire.
 - o **The vehicle transports flammable cargo:** as the cargo is flammable, any accidents may involve cargo spillage or fire, or a vehicle fire due to the fuel. In this case, fuel tank spillage is not considered relevant as the possibility of cargo

spillage, which has a much greater environmental impact, is assessed, as indicated in the methodology developed in MIRAT.

- o The vehicle transports non-flammable cargo: in this case, the possibility that the vehicle is carrying a loaded non-flammable load would be considered, so that the accident scenario would be related to the load - spillage - or to the fuel - vehicle fire. Again, fuel tank spillage is not considered relevant as the possibility of cargo spillage, which has a much greater environmental impact, is assessed, as indicated in the methodology developed in MIRAT.



Figure 12.3.1-1. Drop down menu for vehicle load type. Source: SIRMA.

Below this box, on the right-hand side of the screen, is the **‘Consult’** button. Clicking on this button will take you to the ‘Estimation of the probability of the initiating event’ screen.

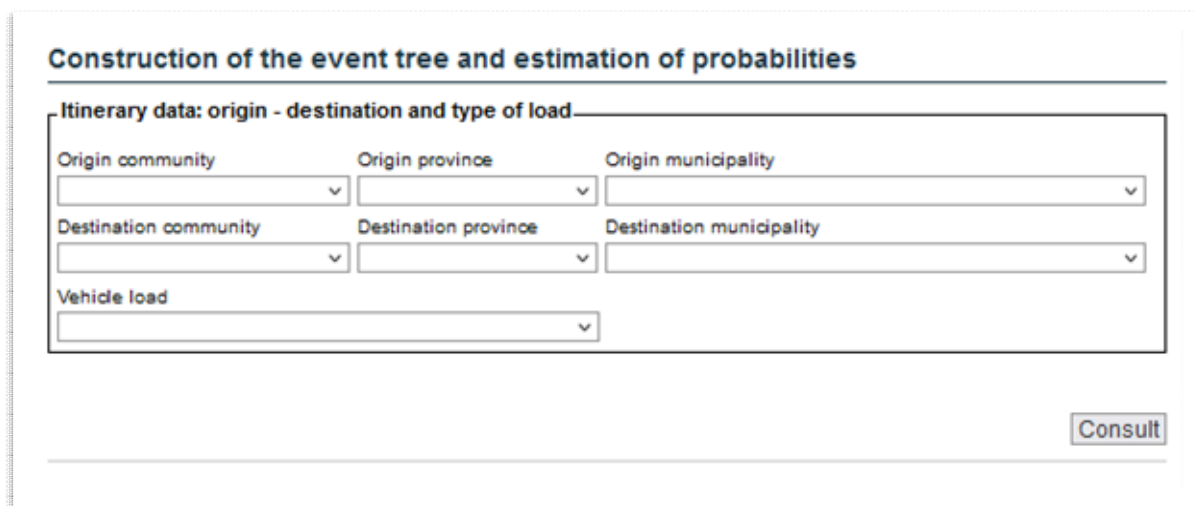
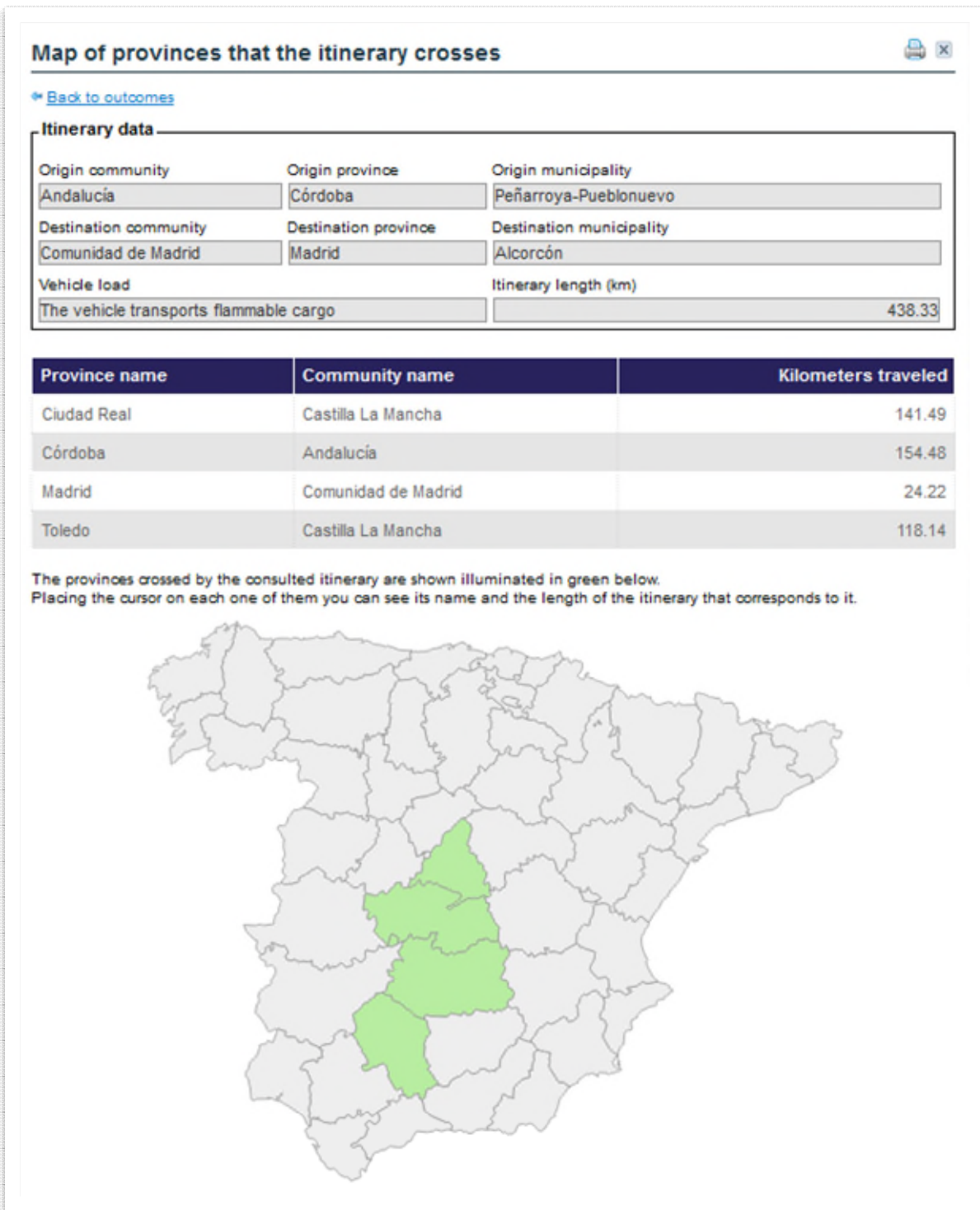


Figure 12.3.1-2. Initial screen of the ‘Transport module’. Source: SIRMA.

12.3.1.1. ESTIMATION OF THE PROBABILITY OF THE INITIATING EVENT

In the ‘Estimation the probability of the initiating event’ screen, you will first find the itinerary data entered in the previous step of ‘Construction of the event tree and estimation of probabilities’. In



one, a label appears with the name of the province and the length in kilometres of the route crossed.

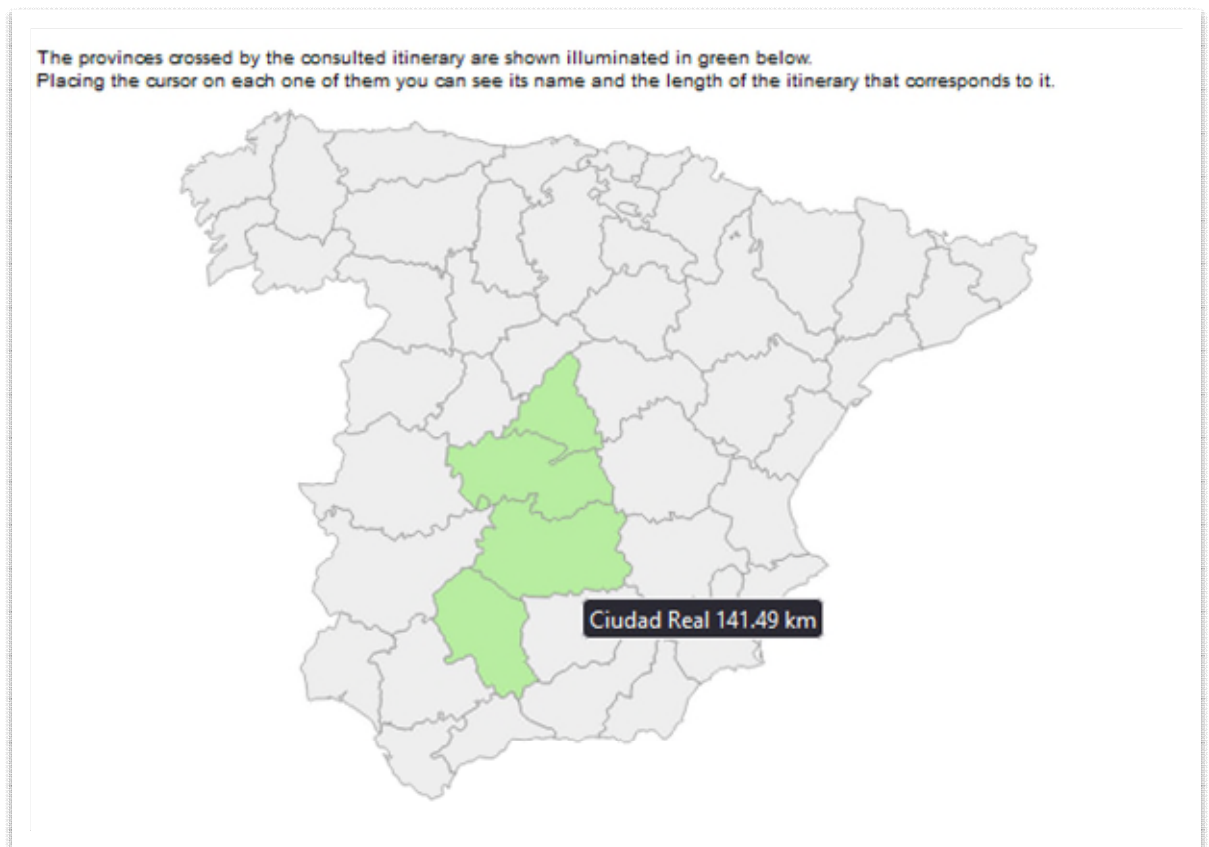


Figure 12.3.1.1-3. Itinerary provinces map (detail). Source: SIRMA.

Click on the hyperlink in the top left-hand corner of the screen: By clicking on 'Back to outcomes', you will go back to the 'Estimation of the probability of the initiating event' screen.

- **Itinerary natural resources:** By clicking on this button, the application will open a new query screen that will again show the basic data of the route and, in the form of a table, the probability for the entered route to have an impact on each of the natural resources under consideration.

Itinerary natural resources




[* Back to outcomes](#)

Itinerary data

Origin community	Origin province	Origin municipality
Andalucía	Córdoba	Peñarroya-Pueblonuevo
Destination community	Destination province	Destination municipality
Comunidad de Madrid	Madrid	Alcorcón
Vehicle load	Itinerary length (km)	
The vehicle transports flammable cargo	438.33	

Structural type code	Structural type name	Probability	Resource code	Resource name	Probability
ARBMADNEP	Mature woodland no protected area	0.0839913202827555405	ASUP	Agua superficial	0.019831255795
			ASUB	Agua subterránea	0.124987480326
			COSTAASUB	Costa con agua subterránea	0.00
			COSTASINASUB	Costa sin agua subterránea	0.00
ARBMADEP	Mature woodland protected area	0.16385795049224444595	ASUP	Agua superficial	0.0738788935914
			ASUB	Agua subterránea	0.38686962285
			COSTAASUB	Costa con agua subterránea	0.00
			COSTASINASUB	Costa sin agua subterránea	0.00

Figure 12.3.1.1-4. Itinerary natural resources (detail). Source: SIRMA.

The fields in the resource tally table for the route are as follows:

- o Structural type code: It reflects the structural type of code according to the maximum current Forest Map of Spain, which is obtained by combining the Forest Map of Spain at 1:50,000 with the new provinces that are generated from the Forest Map of Spain at 1:25,000. The code is also an indication of whether the site is in a secure space. The following codes may appear in the table:

Structural type code	Structural type name
ARBMAADNEP	Mature woodland no protected area
ARBMADEP	Mature woodland protected area
ARBJOVNEP	Young woodland no protected area
ARBJOVEP	Young woodland protected area
HERBNEP	Grassland no protected area
HERBEP	Grassland protected area
SUELONEP	Natural soil without forest vegetation or artificial soil no protected area
SUELOEP	Natural soil without forest vegetation or artificial soil protected area
HUMNEP	Wetland no protected area
HUMEP	Wetland protected area

Table 12.3.1.1-1. Codes and names of the types of structures that are used in the 'Transport Module'. Source: SIRMA.

- o Structural type name: The name of the type of structure, again in accordance with the Forest Map of Spain (see table above).
- o Probability: This is the probability that the structure type in question will be affected. It is calculated as the ratio of the length of the route that runs along this type of structure to the total length of the route.
- o Resource code: For each structural type identified, it indicates the resources that can be contained in each of them. In this case, they are indicated by an identifying code.

Resource code	Resource name
ASUP	Superficial water
ASUB	Groundwater
COSTAASUB	Coast with groundwater
COSTASINASUB	Coast without groundwater

Table 12.3.1.1-2. 'Transport Module' codes and names of natural resources. Source: SIRMA.

- o Resource name: For each structural type identified, it again lists the names of the resources that can be contained in each of them. (See the table above).

- o **Probability:** The probability of an accident occurring in a particular type of resource from those listed in the table above is given for each type of structure. The final probability of the accident scenarios is calculated from these probabilities.

Again, using the hyperlink at the top left of the screen: By clicking on 'Back to outcomes', you will go back to the 'Estimation of the probability of the initiating event' screen.

The screen contains a table with the following information below the two buttons described above:

- **Code:** It specifies, by means of a code, the type of accident outcome and hence the type of event tree through which the accident scenarios are obtained for each initiating event. The codes are the same as those shown in the table below.

Code	Name
ICAR	Cargo fire
IVEH	Vehicle fire
VCAR	Cargo spill
VDEP	Vehicle fuel tank spill

Table 12.3.1.1-3. 'Transport Module' codes and names of natural resources. Source: SIRMA.

- **Name of event/delay:** Depending on whether the vehicle is empty or not and whether it is carrying a flammable load, it represents the type(s) of outcome(s) of a given accident (see table above).
- **Probability:** This is the probability associated with each initiating event. It is calculated using the MIRAT method for the road transport sector.
- **Conditioning factors:** This section of the table contains a Report icon which allows you to access the Conditioning Factors screen described in the following paragraph '12.3.1.2. Conditioning factors of the outcome' for each initiating/disrupting event.
- **Accidental scenarios:** This table cell contains a report icon to access the Accident Scenarios screen described in section '12.3.1.3. Accident scenarios (by outcome and effect of conditioning factors)' for each initiating/disrupting event.

Click on the hyperlink in the top left-hand corner of the screen: by clicking on the 'Back to outcomes' button, you can return to the initial screen and enter a new itinerary.

12.3.1.2. CONDITIONING FACTORS OF THE OUTCOME

As mentioned in the previous section, if you click on the report icon in the 'Conditioning factors' section of the table that appears in the 'Estimation of the probability of the initiating event' screen for a particular trigger, the application will open a query window showing the conditioning factors that modify the probability of that trigger.

Conditioning factors of the outcome

[Back to outcomes](#)

Itinerary data

Origin community	Origin province	Origin municipality
Andalucía	Córdoba	Peñarroya-Pueblonuevo
Destination community	Destination province	Destination municipality
Comunidad de Madrid	Madrid	Alcorcón
Vehicle load	Itinerary length (km)	
The vehicle transports flammable cargo	438.33	
Outcome name	Code	Probability
Cargo fire	ICAR	0.0183686579579145015

Code	Name	Performance parameters	Fail probability
ETSE	Early extinction by emergency services	Acts first	0.50

Figure 12.3.1.2-1. Factors conditioning the outcome. Source: SIRMA.

The screen contains a table with the following information in addition to the general route data table:

- **Code:** It is the code assigned to this conditioning factor. It corresponds to the acronym of the name of the factor according to the table:

Code	Name
CTT	Early containment by crew
CTSE	Early containment by emergency services
ETT	Early extinction by crew
ETSE	Early extinction by emergency services

Table 12.3.1.2-1. Conditioning factor codes and names used in 'Transport Module' .

Source: SIRMA.

- **Name**: Indicates the full name that has been assigned to the conditioning factor in question (see the table above).
- **Action parameters**: It shows how the conditioning factors are applied in relation to the type of event tree that has been used: the order of actions and the success or failure of those actions.
- **Failure probability**: It represents the probability that the conditioning factors involved will fail.

It is possible to return to the 'Estimation of the probability of the initiating event' screen using the 'Back to outcomes' link at the top left of the screen.

12.3.1.3. ACCIDENT SCENARIOS (ACCORDING TO OUTCOME AND ACTION OF CONDITIONING FACTORS)

Finally, as indicated in section 12.3.1.1, for a given initiating event, by clicking on the report icon in the 'Accident scenarios' section of the table in the 'Estimation of the probability of the initiating event' screen, the application opens a query window showing the occurrence scenarios derived from this initiating event after applying the conditioning factors.

Accident scenarios (according to outcome and action of conditioning factors)

[Back to outcomes](#)

Itinerary data

Origin community	Origin province	Origin municipality
Andalucía	Córdoba	Peñarroya-Pueblonuevo
Destination community	Destination province	Destination municipality
Comunidad de Madrid	Madrid	Alcorcón
Vehicle load	Itinerary length (km)	
The vehicle transports flammable cargo	438.33	
Outcome name	Code	Probability
Cargo fire	ICAR	0.0183686579579145015

Event tree

Code	Probability	Steps	Detail
ICAR-E.1	0.00001529790839639245	ETSE Yes, ARBMADNEP Yes, ASUP Yes	
ICAR-E.2	0.00009450378485643958	ETSE Yes, ARBMADNEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.3	0.00066160222360095969	ETSE Yes, ARBMADNEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.4	0.00011118221781114978	ETSE Yes, ARBMADEP Yes, ASUP Yes	
ICAR-E.5	0.00053919686950776555	ETSE Yes, ARBMADEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.6	0.00085454623581954782	ETSE Yes, ARBMADEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.7	0.00000163266479953561	ETSE Yes, ARBJOVNEP Yes, ASUP Yes	
ICAR-E.8	0.0000719144328062372	ETSE Yes, ARBJOVNEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.9	0.00010709322256608232	ETSE Yes, ARBJOVNEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.10	0.00002214913320744737	ETSE Yes, ARBJOVEP Yes, ASUP Yes	
ICAR-E.11	0.0000392358712770729	ETSE Yes, ARBJOVEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.12	0.00006505888517025481	ETSE Yes, ARBJOVEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.13	0.00000511294717546886	ETSE Yes, HERBNEP Yes, ASUP Yes	
ICAR-E.14	0.00000699052936715303	ETSE Yes, HERBNEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.15	0.00004047137738541805	ETSE Yes, HERBNEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.16	0.00000210728768893785	ETSE Yes, HERBEP Yes, ASUP Yes	
ICAR-E.17	0.00004534989045945118	ETSE Yes, HERBEP Yes, ASUP No, ASUB Yes, COSTAASUB No	
ICAR-E.18	0.00023733592125289985	ETSE Yes, HERBEP Yes, ASUP No, ASUB No, COSTASINASUB No	
ICAR-E.19	0.00002400754644098199	ETSE Yes, SUELONEP Yes, ASUP Yes	

Figure 12.3.1.3-1. Accident scenarios – according to outcome and action of conditioning factors - (detailed). Source: SIRMA.

In addition to the general route data table present in all the ‘Transport Module’ screens, this screen contains a table with the following information:

- **Code**: This is an alphanumeric code. It is used to identify the accident scenario. It consists of the initiating event code from which it is derived. It is separated by a hyphen from the scenario number assigned to it.
- **Probability**: By applying the event tree, this is the final probability calculated for the scenario.
- **Steps**: These are the steps that have been in place to have the probability of the accident scenario. Example: ETSE Involved, ARBMADEP Involved, ASUP Not Involved, ASUB Not Involved, COSTASINASUB Not Involved; would indicate that early extinguishing by the emergency services has been successful, that mature forest in a protected area is affected, that there is no surface or ground water and that there is no coastline.
- **Detail**: By clicking on the report icon, the application displays a new screen showing, besides the general itinerary data, a table containing:
 - o **Element**: Displays each of the elements in the event tree construction process that are determinants of the accident scenario. This is the case for both the conditioning factors that are applicable to the initiating event and the natural resources that may be affected by the accident scenario.
 - o **Involved**: Indicates whether the element is part of the assessment of the accident scenario which is being queried.
 - o **Probability variation**: Records the specific probability value of the element in question.
 - o **Probability**: After applying the element in question, this reflects the change in the final probability of the scenario.

Detail of the accident scenario




[* Back to scenarios](#)

Itinerary data

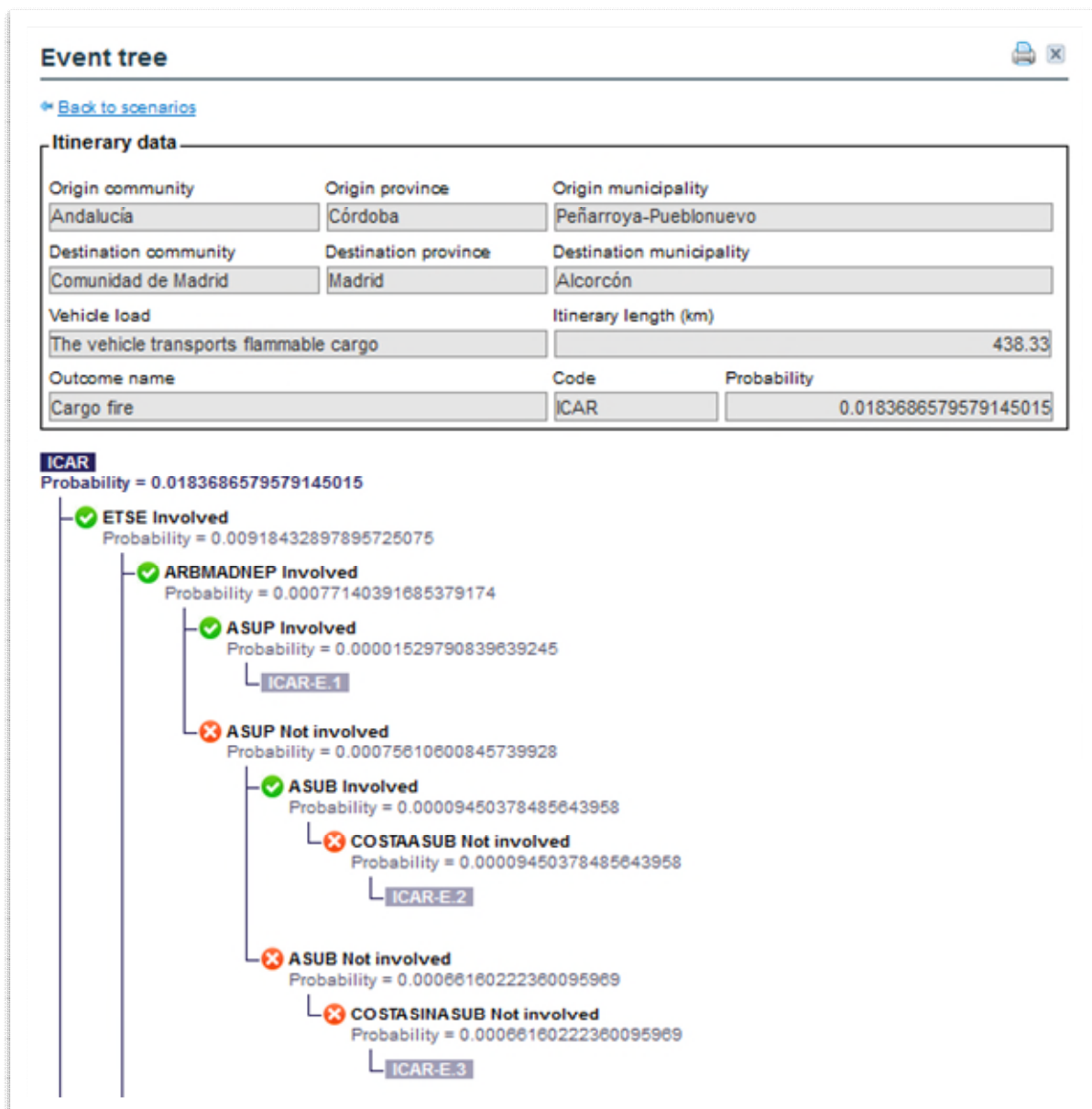
Origin community	Origin province	Origin municipality
Andalucía	Córdoba	Peñarroya-Pueblonuevo
Destination community	Destination province	Destination municipality
Comunidad de Madrid	Madrid	Alcorcón
Vehicle load	Itinerary length (km)	
The vehicle transports flammable cargo	438.33	
Outcome name	Code	Probability
Cargo fire	ICAR	0.0183686579579145015
Scenario	Probability	
ICAR-E.3	0.00066160222360095969	

	Element	Involved	Probability variation	Probability
1	ETSE	Yes	0.50	0.00918432897895725075
2	ARBMADEP	Yes	0.08399132028275555405	0.00077140391685379174
3	ASUP	No	0.980168744205	0.00075610600845739928
4	ASUB	No	0.875012519674	0.00066160222360095969
5	COSTASINASUB	No	1.00	0.00066160222360095969

Figure 12.3.1.3-2. Detail of the accidental scenario. Source: SIRMA.

It is possible to return to the 'Accident scenarios (according to outcome and action of conditioning factor)' screen by clicking on the 'Back to scenarios' link at the top left of the screen.

In the central part of the Accident Scenarios screen derived from a given initiating event, between the route data and the accident scenarios table, is the 'Event tree' button. Clicking on it will open the window with the event tree diagram for the trigger event being consulted. The screen re-displays the route data and, immediately afterwards, the drawing of the accident tree to be consulted, with all the involved elements to the definition of the accident scenarios derived from it.



12.4. PRINTABLE REPORT

The 'Transport Module' does not store the queries made by the user, but it does allow the generated report to be saved or printed using the '**Printer**' icon () located in the top right-hand corner of the screens. Therefore, by clicking on this icon, the application allows the user to view the report that has been generated so far. It can then be archived or printed if the user so wishes.



Comisión Técnica de Prevención
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Medioambientales



Transport Module - Event tree

Itinerary data

Origin community	Origin province	Origin municipality
Andalucía	Córdoba	Peñarroya-Pueblonuevo
Destination community	Destination province	Destination municipality
Comunidad de Madrid	Madrid	Alcorcón
Vehicle load	Itinerary length (km)	
The vehicle transports flammable cargo	438.33	

Provinces that the itinerary crosses

Province name	Community name	Kilometers traveled
Ciudad Real	Castilla La Mancha	141.49
Córdoba	Andalucía	154.48
Madrid	Comunidad de Madrid	24.22
Toledo	Castilla La Mancha	118.14

Itinerary natural resources

Structural type code	Structural type name	Probability	Resource code	Resource name	Probability
ARBMADNEP	Mature woodland no protected area	0.0839913202827555405	ASUP	Agua superficial	0.019831255795
			ASUB	Agua subterránea	0.124987480326
			COSTAASUB	Costa con agua subterránea	0.00
			COSTASINASUB	Costa sin agua subterránea	0.00

Figure 12.4-1. 'Transport Module' printable report (detail). Source: SIRMA.

Use the print option in the browser menu to print/save as a PDF. Among the configuration options offered by the browsers, the user must ensure that the option that allows images to be printed is enabled, as described in the figures below (depending on the browser used).

Mozilla Firefox:

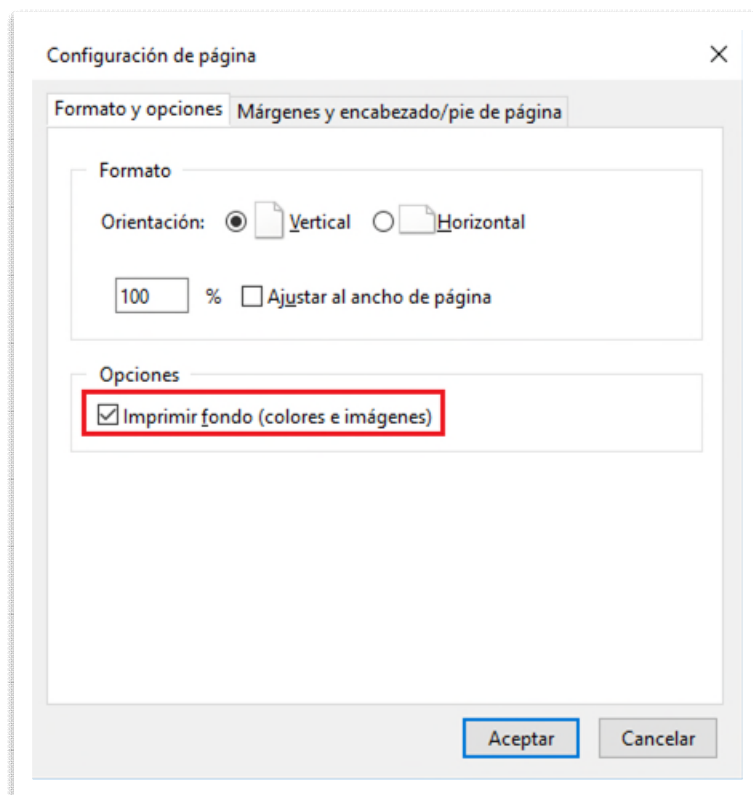
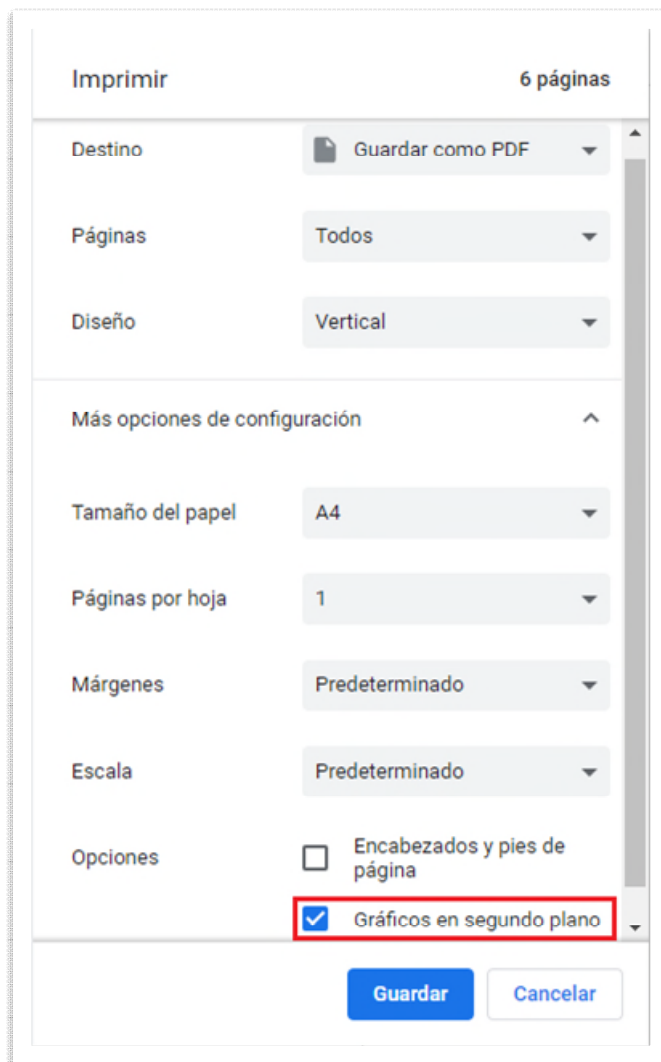


Figure 12.4-2. Mozilla Firefox configuration screen for printing report. Source: Mozilla Firefox.

Google Chrome:



Imprimir 6 páginas

Destino Guardar como PDF

Páginas Todos

Diseño Vertical

Más opciones de configuración

Tamaño del papel A4

Páginas por hoja 1

Márgenes Predeterminado

Escala Predeterminado

Opciones

☐ Encabezados y pies de página

☒ Gráficos en segundo plano

Guardar Cancelar

Figure 12.4-3. Google Chrome configuration screen for printing report. Source: Google Chrome.

Internet Explorer:

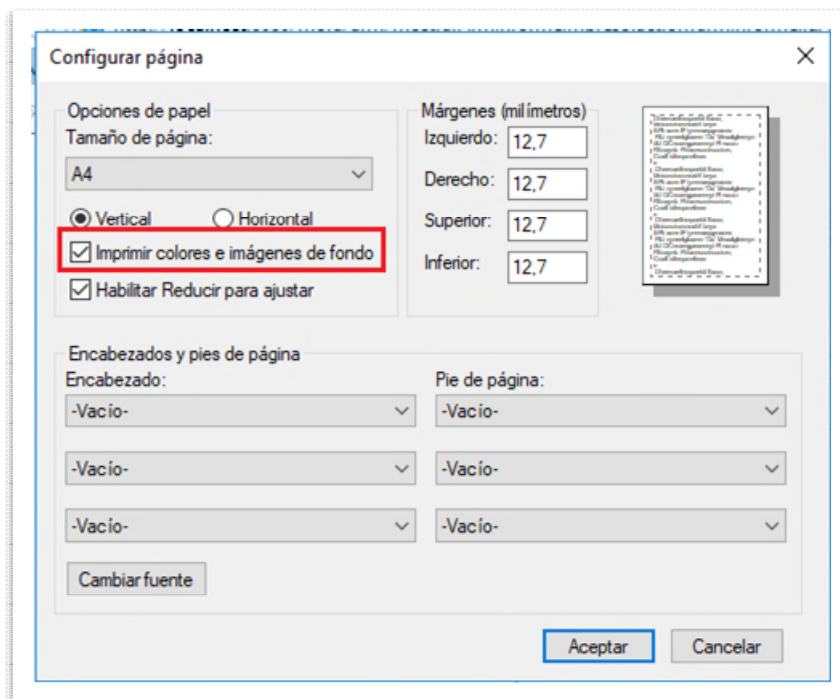


Figure 12.4-4. Internet Explorer configuration screen for printing report. Source: Internet Explorer.



GOBIERNO
DE ESPAÑA

MINISTERIO
PARA LA TRANSICIÓN ECOLÓGICA
Y EL RETO DEMOGRÁFICO

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TECHNICAL COMMISSION OF PREVENTION AND REMEDIATION OF ENVIRONMENTAL DAMAGES