

Decision Support System – User Guide

LIFE15 ENV/ES/000598

**Development of an efficient and sustainable methodology
for EMerging POLLutants REMoval in WWTPs**

LIFE EMPORE

Programming and user quick-guide

The computer programming of the DSS was developed under Microsoft Visual Basic for Application 7.0 of Excel 2010. The program follows the logic of the DSS flow diagram and it is explained in the following screenshots.

In this section the case under study, Benidorm's WWTP, is used to exemplify how the programme works.

The program begins with a brief introduction explaining the main objective of the DSS and the main steps that follow as shown in Figure 1-1. From this window, it is also possible to access the webpage of the project from the left bottom link.



Figure 1-1 DSS starting window

General features:

- Cancel buttons ask the user to confirm if it is wanted to exit the program.
- Clean buttons restore all form values.

Before each step starts a message dialog box pops out giving an explanation of the objectives and requirements as shown in Figure 1-2

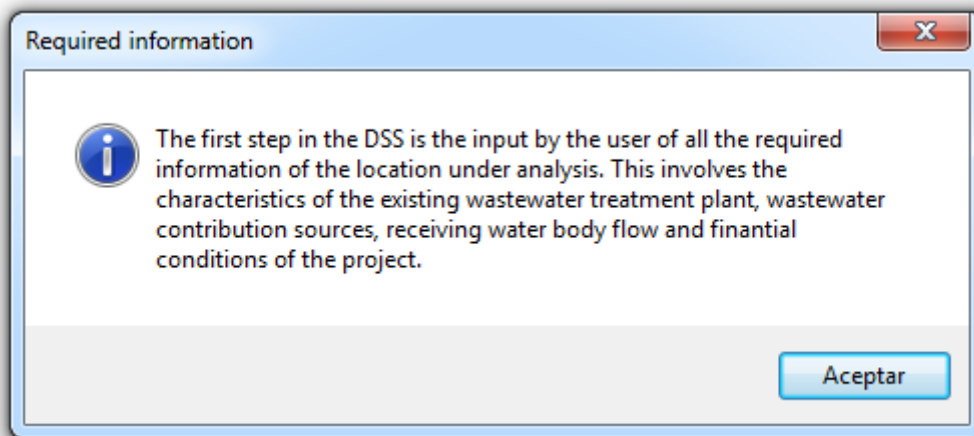


Figure 1-2 Required information message

Once the user clicks the accept button, the "STEP 1: information input" window is shown (Figure 1-3).

A window titled "STEP 1: Information input" with a close button (X) in the top right corner. It contains several input fields and checkboxes for data entry:

- WWTP Name/City: Text box containing "Benidorm"
- Country: Dropdown menu showing "Spain"
- Wastewater source activity: Four checkboxes: "Domestic" (checked), "Industrial" (checked), "Agriculture" (checked), and "Hospitals" (unchecked)
- WWTP capacity (m3/day): Text box containing "62.320"
- Wastewater discharge: Dropdown menu showing "Marine water body"
- Existing WWTP technology: Dropdown menu showing "Advanced treatment"
- Percentage of the flow that is going to feed the advanced treatment process (%): Text box containing "50"
- Sewage sludge management: Dropdown menu showing "Properly treated and dispose"
- Interest rate (%): Text box containing "3"
- Lifespan of the project (years): Text box containing "20"

At the bottom, there are three buttons: "Next", "Clean", and "Cancel".

Figure 1-3 STEP 1: Information input window

As it can be seen, some information is required to be typed, while other should be selected from a dropdown menu or by clicking on a check-box.

The deployable “wastewater discharge” button allows selecting among different wastewater discharge options. If the WWTP discharges into a lotic water body, then the stream flow is required in order to calculate the dilution factor and the estimated concentration of the reference compound.

The following inputs need to be clarified:

- Receiving water body flow should be the 10th percentile of the flow data series or, in its absence, 1/3 of the average flow.
- “Tertiary treatment” stands for nutrient removal, while “Advanced treatment” refers to advanced micropollutants removal techniques.

If “Advanced treatment” is selected as the existing technology, then a new window pop-ups in which the user can select among the advanced technologies applied in the project (Figure 1-4).

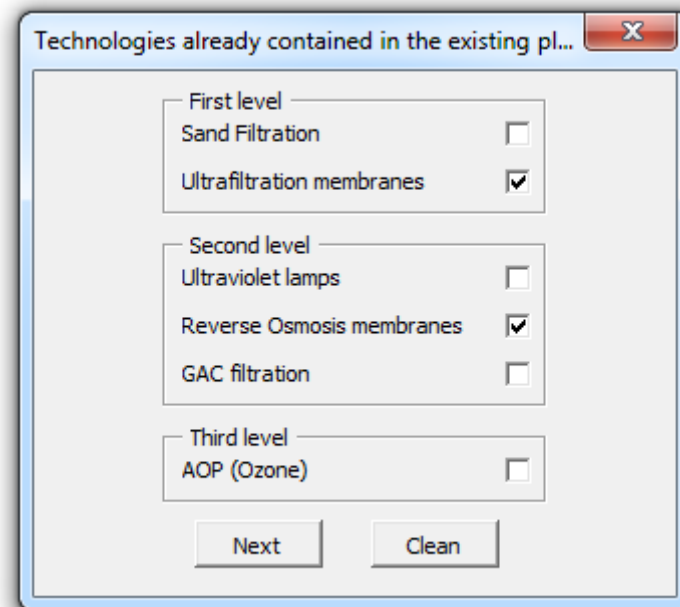


Figure 1-4 Advanced technologies present in the existing plant

Selected technologies are not included in the CAPEX and OPEX estimation, neither in the energy consumption nor in the unitary water production costs; since this cost is already part of the produced wastewater.

As a result of selecting “Properly treated and disposal” sludge management, another window pop-ups in which the user can select among the most used final disposition methods in Europe as shown in Figure 1-5

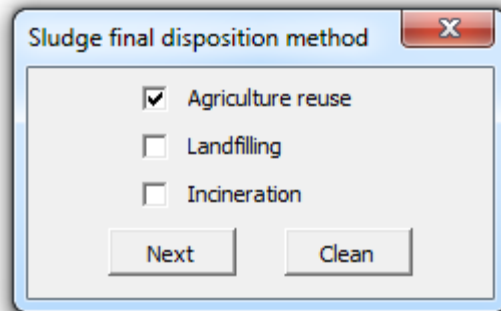


Figure 1-5 Sewage sludge final disposition methods

After the user clicks on next button, a message appears explaining the functioning of the step and the link between the input information and the questionnaire (Figure 1-6)

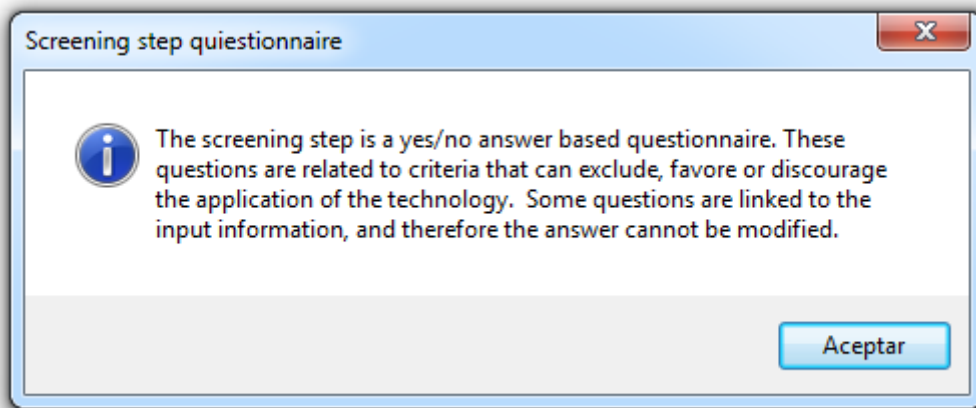


Figure 1-6 Questionnaire message

The screening step is a "yes/no" answer-based questionnaire as shown in Figure 1-7. Questions 2, 4, 8 and 9 are linked to the input information and therefore they cannot be modified.

STEP 2: Screening

1. Are there known issues of micropollutants in the wastewater treatment plant? Yes No
2. Is there a secondary treatment as a minimum level of treatment? Yes No
3. Is there enough power supply availability to feed the advanced treatment, as well as willingness to pay for the extra energy costs that carry these technologies? Yes No
4. Are there different sources of wastewater contribution other than domestic? Yes No
5. Is there a need for wastewater reuse in this area? Yes No
6. Is the receiving water body compromised? Yes No
7. Is the wastewater discharged upstream a drinking water treatment plant intake? Yes No
8. Is the sewage sludge properly treated and managed? Yes No
9. Is the sludge final disposal method aligned with the micropollutant removal objectives? Yes No
10. Is there any local regulation or policy regarding micropollutants? Yes No

Screen Cancel

Figure 1-7 STEP 2: Screening questionnaire window


If selected answers lead to the satisfaction of the screening step, then the “Screening step satisfied” message will appear. Otherwise, an alert message shows the reason why the screening step was not satisfied, followed by the closure of the program.

These reasons can be:

- The not compliance of a minimum level of treatment,
- The non-management of sewage sludge,
- The not compliance of a minimum number of positive answers.

Previous to the evaluation step a message box is deployed, this explains the evaluation criteria aspects and the required information (Figure 1-8).

Evaluation step required information

 The evaluation step is a multi-criteria based analysis, considering economic, social and environmental aspects. The output of this step is summarized in a 0 to 100 total score, which has a related transferability classification.

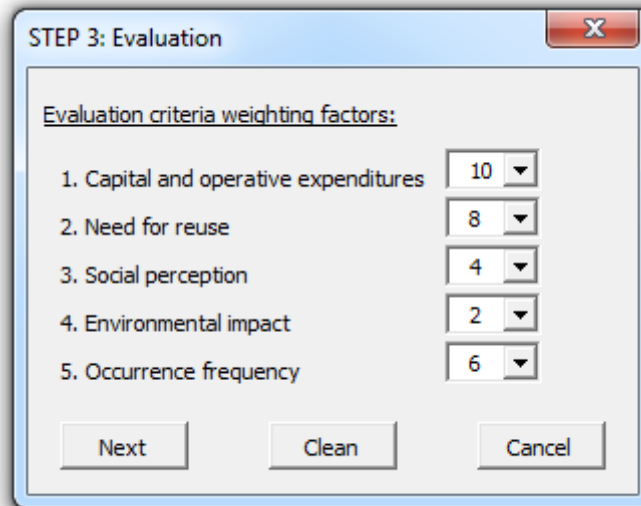
Prior the evaluation process begins it is required to input weighting factors from 1 to 10, where 1 is considered for criteria of low importance and 10 for criteria of high importance.

Aceptar

Figure 1-8 Evaluation step required information message

Once the user clicks over the accept button the Evaluation information windows appears, requiring to enter additional information before the evaluation step begins (Figure 1-9).

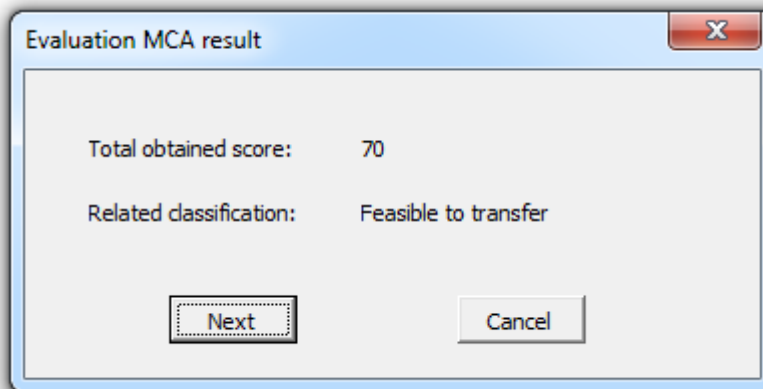
As it is mentioned in the previous dialog box weighting factors should be natural numbers, which can range from 1 to 10 (where 1 is considered for criteria of low importance and 10 for criteria of high importance).



Criteria	Weighting Factor
1. Capital and operative expenditures	10
2. Need for reuse	8
3. Social perception	4
4. Environmental impact	2
5. Occurrence frequency	6

Figure 1-9 STEP 3: Evaluation information window

The next button conducts to the total obtained score and related classification as shown in Figure 1-10.



Total obtained score:	70
Related classification:	Feasible to transfer

Figure 1-10 Multi criteria analysis result

Finally, the user can access to a summarized report containing information related to each evaluation indicator (Figure 1-11. Detailed graphs and tables of these indicators are accessible by clicking over each identified button.

The excel sheet containing the database information, as well as all the black box calculation can be accessed from the "Excel Spreadsheet" button.

The energy consumption and its price are estimated, but these values are not part of the decision process.

By clicking in the “Add” button is possible to perform a visual comparative analysis of up to five different locations.

DSS summarized report					
WWTP name:	Zagreb	Benidorm	Rome	Rotterdam	Oporto
Country:	Croatia	Spain	Italy	Netherlands	Portugal
Screening:	not satisfied	satisfied	satisfied	satisfied	satisfied
Total score:		64	75	75	51
- Economics:					
CAPEX (million €)	0,00	6,27	30,38	265,89	36,78
OPEX (thousands €/year)	0	741	2.985	22.716	3.555
UWPC (€/m3)		0,50	0,85	0,66	0,81
Energy consumption (kWh)		78	1.132	11.317	1.415
Energy price (€/kWh)		0,10	0,09	0,06	0,08
Energy OPEX (thousands €/year)	0	69	884	6.057	968
- Need for reuse:					
Water exploitation index (%)		29,6	36,3	10,3	15,1
<input type="button" value="WEI Map"/>					
- Social Perception:					
Water pollution perceived by Europeans as the main environmental issue (%)		57,0	51,0	57,0	51,0
<input type="button" value="Social Map"/>					
- Environmental impact of the discharge:					
Dilution factor:		N/A	11,8	11,8	N/A
- Micropollutants occurrence:					
<input type="button" value="NORMAN List"/>					
- Other information:					
<input type="button" value="Excel Spreadsheet"/> <input type="button" value="Add"/> <input type="button" value="Exit DSS"/>					

Figure 1-11 DSS summarized report window