NEREUS Decision Support Tool – User Manual

School of Mathematics and Physics, University of Portsmouth

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User manual for the NEREUS Decision Support Tool (DST) - a web-based tool designed to aid public and private decision-makers in the process of resource recovery from urban wastewater. NEREUS DST provides treatment trains that can recover water, energy and nutrients, while considering environmental and cost factors.

`https://nereus.vito.be/index.html`

Contents

1 Overview of Homepage

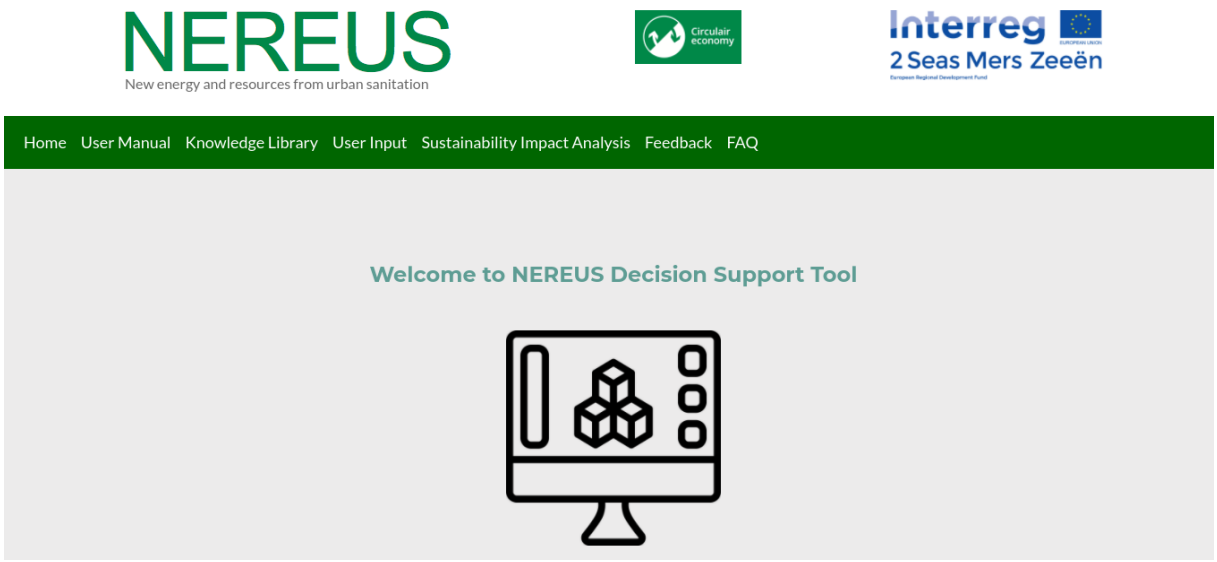

Figure 1: NEREUS Homepage

The important feature of the homepage is the green bar which contains the links to the elements of the DST - including this User Manual. This User Manual will go through the main sections of the tool, detailing what they contain and showing interaction needed by the user.
Read through the homepage to find more information about the NEREUS project.

(Note: All images from DST website are accurate at time of writing, but subject to change as DST is updated.)

2 Knowledge Library

From the Knowledge Library tab there are 2 blue buttons allowing the user to download the current version of the knowledge library and also to upload a new version.

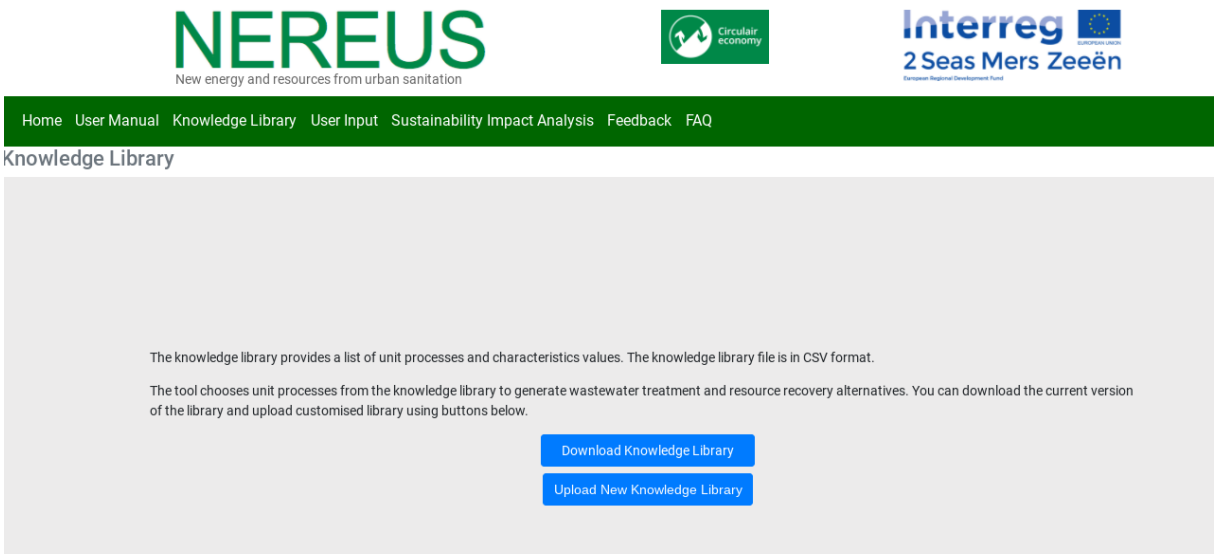

Figure 2: Knowledge Library

The complete knowledge library contains a list of 39 distinct Unit Processes technologies. The knowledge library consists of 37 columns containing details of the various Unit Process characteristics. Figure 3 shows the first rows and columns of the knowledge library template, this image is just to provide a representation of this database and not give specific information on Unit Process values.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Technology	TRL	Lifetime	Max Load TSS	Max Load COD	Max Load TN	Max Load TP	Min Load TSS	Min Load COD	Min Load TN	Min Load TP	TSS Removal	COD Removal
2	Rotary Drum Fir	9	20	8000	1000000000	1000000000	1000000000	500	0	0	0	10	0
3	Microscreens	9	15	8000	1000000000	1000000000	1000000000	500	0	0	0	60	40
4	Bar screen	10	15	1000000000	1000000000	1000000000	1000000000	500	0	0	0	2	1.3
5	Coarse screen	10	15	1000000000	1000000000	1000000000	1000000000	500	0	0	0	5	2
6	Grit Chamber	10	15	1000000000	1000000000	1000000000	1000000000	500	0	0	0	2	2
7	Drum Sieve	9	10	8000	1000000000	1000000000	1000000000	500	0	0	0	80	10
8	Sedimentation v	9	30	1000	1000000000	1000000000	1000000000	500	0	0	0	50	25
9	Sedimentation v	9	30	1000	1000000000	1000000000	1000000000	300	0	0	0	70	50
10	Electrocoagulati	4	15	1000	1000000000	1000000000	1000000000	100	0	0	0	85	50
11	P-Precipitation v	9	30	1000	1000000000	1000000000	1000000000	100	0	0	0	50	25
12	Combination Flc	9	25	1000	1000000000	1000000000	1000000000	100	0	0	0	90	20
13	Activated sludge	10	25	2000	5000	1000000000	1000000000	100	100	5	1	70	80
14	partial nitritatio	9	30	750	1000	2000	10000	0	100	20	5	80	90
15	Aeorobic granul	9	30	2000	5000	1000000000	1000000000	50	100	10	1	20	90
16	Trickling filter w	9	30	1000	2000	1000000000	1000000000	50	100	5	1	70	80
17	Membrane biore	9	15	2000	5000	1000000000	1000000000	0	100	10	5	92	80
18	Constructed we	8	20	1000	2000	1000000000	1000000000	0	100	5	1	75	15
19	Enhanced biolog	9	30	1000	2000	1000	100	0	100	20	5	0	90
20	UASB	7	30	7000	20000	10000	1000	0	1000	20	5	75	90
21	Expanded Granu	9	7	2000	5000	1000000000	1000000000	0	400	0	0	0	90
22	NitrifiDenitrifi	9	30	1000	2000	1000000000	100	0	100	20	5	0	90
23	Dual media filte	9	15	100	300	1000000000	1000000000	0	10	0	0	90	70
24	Microfiltration	9	15	100	300	1000000000	1000000000	0	10	0	0	90	70

Figure 3: Template CSV

Users can utilise the knowledge library template to remove unwanted technology, alter current characteristic values, and add new technology not currently featured in this database. A user created knowledge library can then be used in the DST via the upload button.

3 User Input

The first stage of using the tool is to define the input - with two options:

1. Policy Maker - 4 input sections
2. Technology Expert - a 5th input is available, plus further options for some inputs

3.1 Site Details

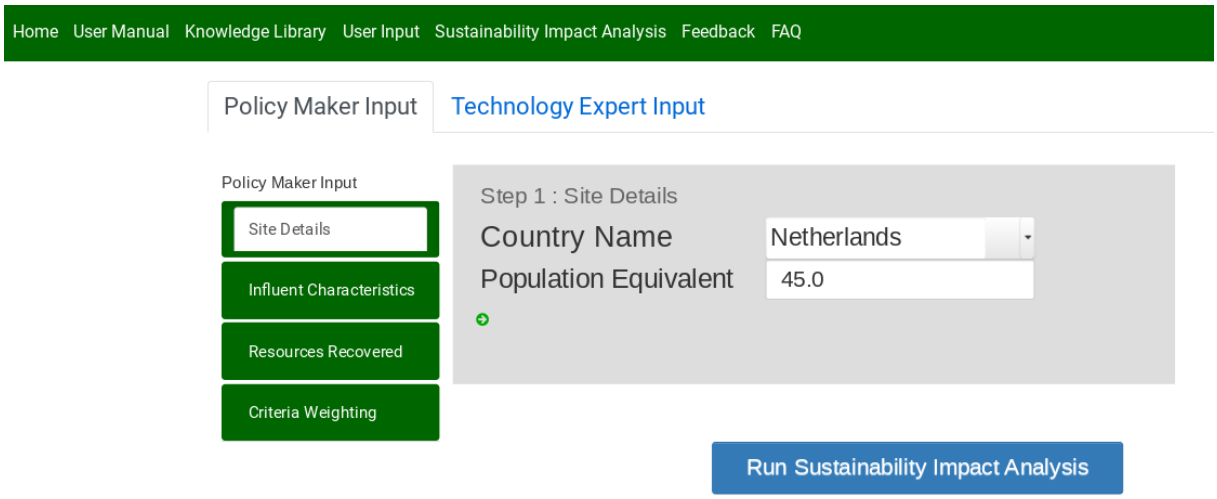

Figure 4: Site Details Input

The site details contain a drop down list of the four countries involved in this project (Netherlands, UK, France, Belgium) and and an input box for population equivalent. Population equivalent, in waste-water treatment, refers to the amount of oxygen-demanding substances whose oxygen consumption during biodegradation equals the average oxygen demand of the waste water produced by one person.

Clicking the green arrows (where available) allows for quicker navigation through the list of input subjects in the right-hand column.

3.2 Inluent Characteristics

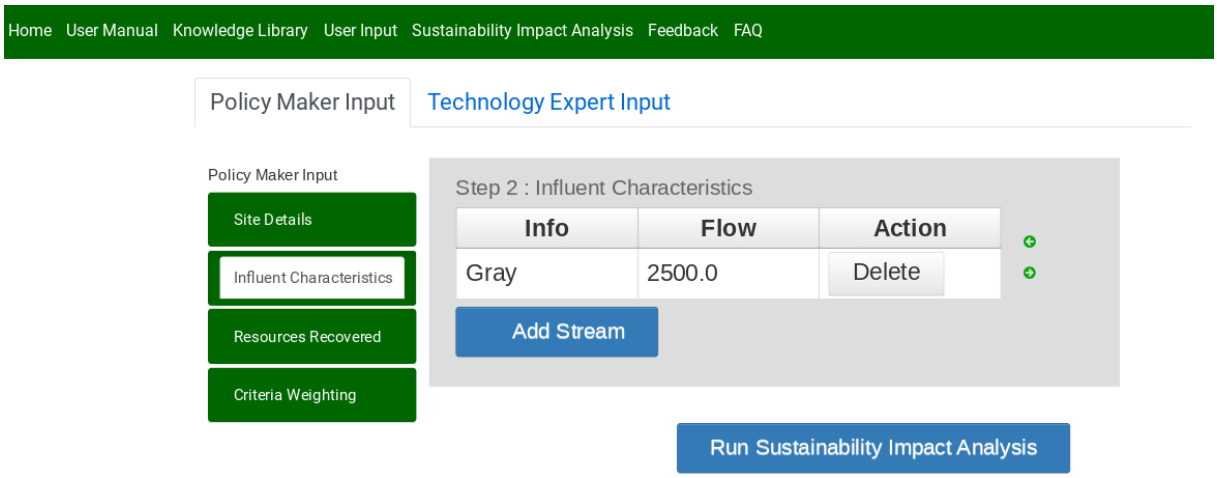

Figure 5: Add Stream Input for Policy Maker

The influent input has an 'Add Stream' button this allows a Policy Maker user to add the wastewater type (from a list of Gray, Black, Mixed, or Customised) and the flow in m^3/day. The option to perform the action of deleting stream is possible here, if the values for the stream need changing.

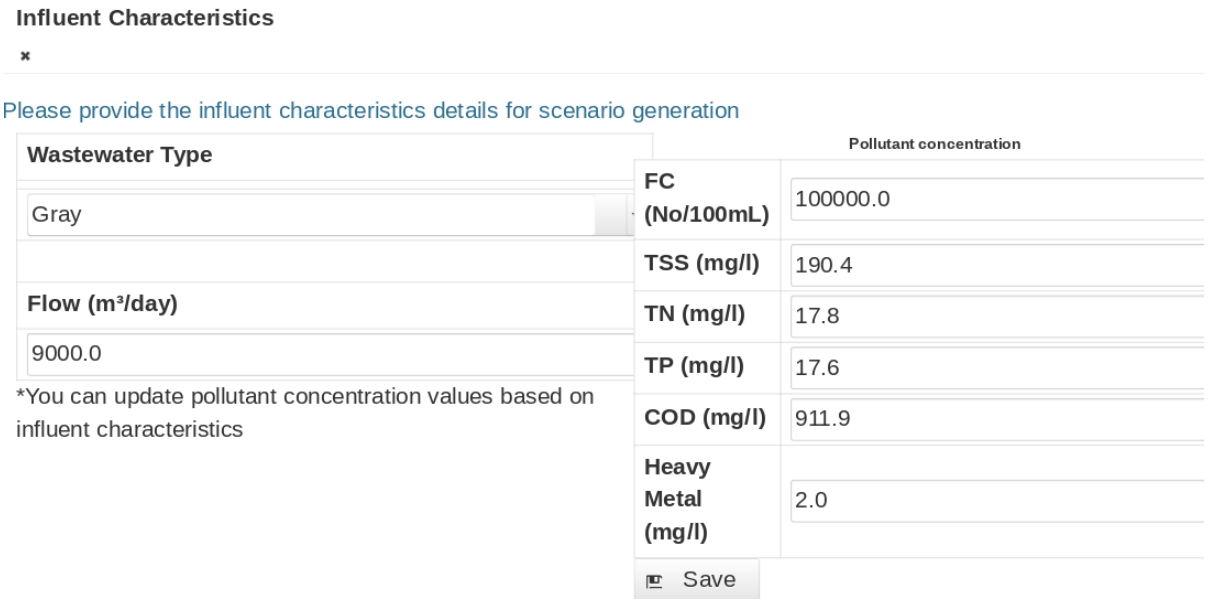

Figure 6: Influent Characteristics Input for Technology Expert

For a Technology Expert user they will get the more detailed options for a new stream as seen in Figure 6. This adds the ability to update pollutant concentration values based on

influent characteristics. The values shown are the default values that can be customised by the user.

3.3 Resources Recovered

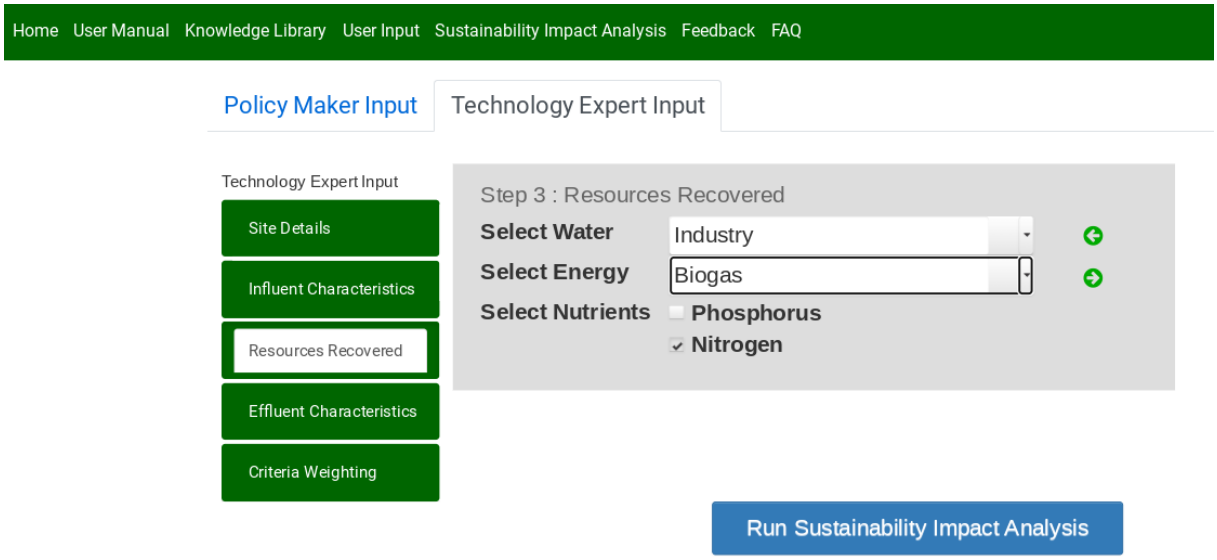

Figure 7: Resources Recovered Input

The resources recovered input requires three selection; Water, Energy, and Nutrients. The water options are Drinking, Industry, Irrigation, and Discharge Only. Energy is represented by Biogas, and the Nutrient recovery selection is Phosphorous, Nitrogen or both nutrients. If the user does not want to recover any energy or nutrients they can select Discharge Only from the water options.
(Note: Figure 7 is taken from the Technology Expert Input section and contains all 5 input fields on the left-hand side.)

3.4 Criteria Weighting

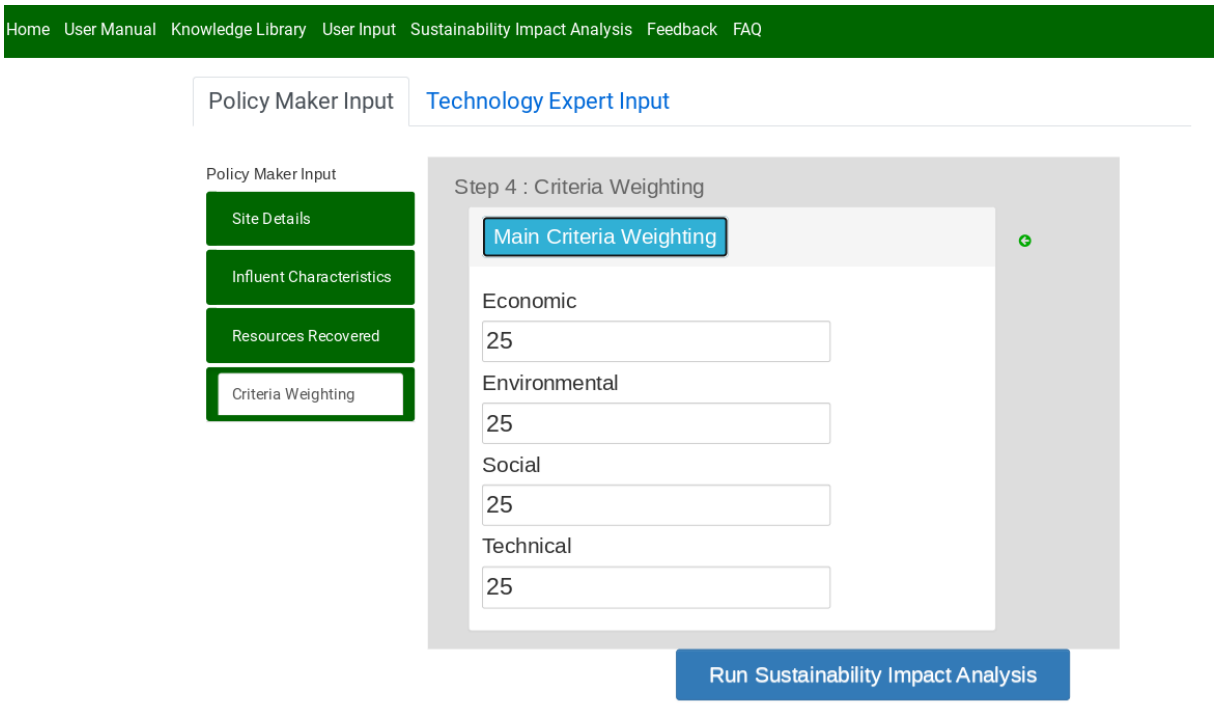

Figure 8: Criteria Weighting Settings

The criteria weighting allows setting the weight values for the 4 objectives in the optimization model. They are default set at a balance between the objectives - equal at 25%. These numbers should sum to 100 or an error will occur resulting in a message informing the user to change the values if they attempt to run the tool.

The four areas of sustainability in the model:

1. Economic - Capital Expenditure, Operating Expenditure, Willingness to Pay, and Potential Income Generated
2. Environmental - Odour, Land Footprint, Health LCA, Ecosystems LCA, Resources LCA, and Climate Change LCA
3. Social - Affordability and Acceptability
4. Technical - Technology Readiness Level (TRL) and Flexibility

(Note: Specific details for the calculations of these measures and their inclusion in the weighted multi-objective non-linear optimization model not included in this User Manual.)

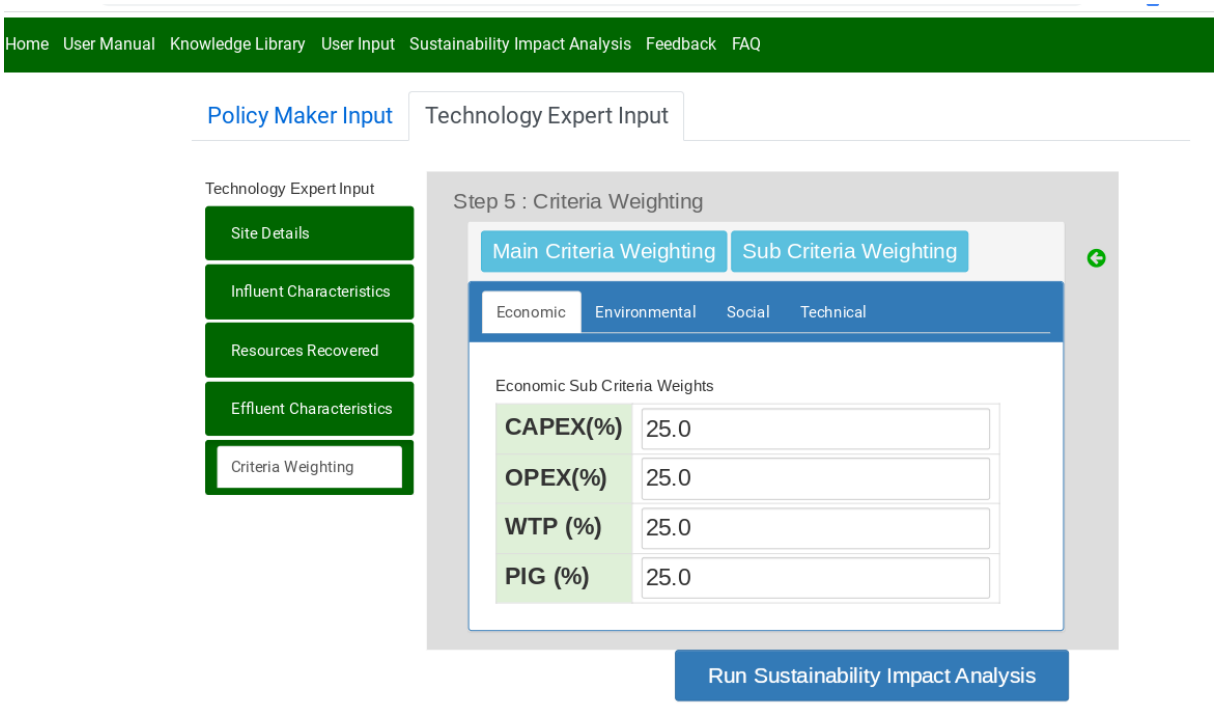

Figure 9: Economic Expert Sub-Criteria Settings

The components of each of the 4 dimensions of sustainability, from the above list, can be given their own individual weighting. The example given in Figure 9 shows the individual sub-criteria for the Economic related measures, with even weighting for each adding to 100%.

3.5 Effluent Characteristics

The Technology Expert setting has an extra input field for Effluent characteristics. These are the desirable levels of quality of the selected recovery water type, with an example of Industry water and the 5 properties available, and the default values, shown in Figure 10.

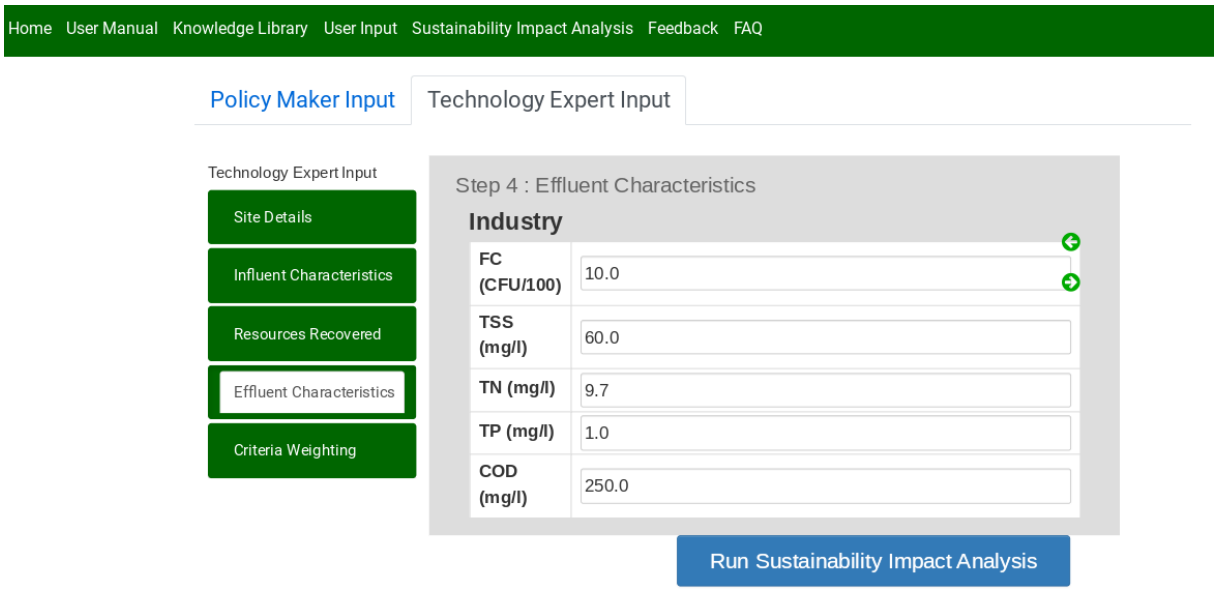

Figure 10: Effluent Characteristics Input

Once all the inputs are set by the user the **Run Sustainability Impact Analysis** button, seen at the bottom of the above Figures, can be hit to start the analysis. If feasible solutions are found the **Sustainability Impact Analysis** tab will open.

4 DST Output – Impact Analysis

4.1 Treatment Train for Recovery

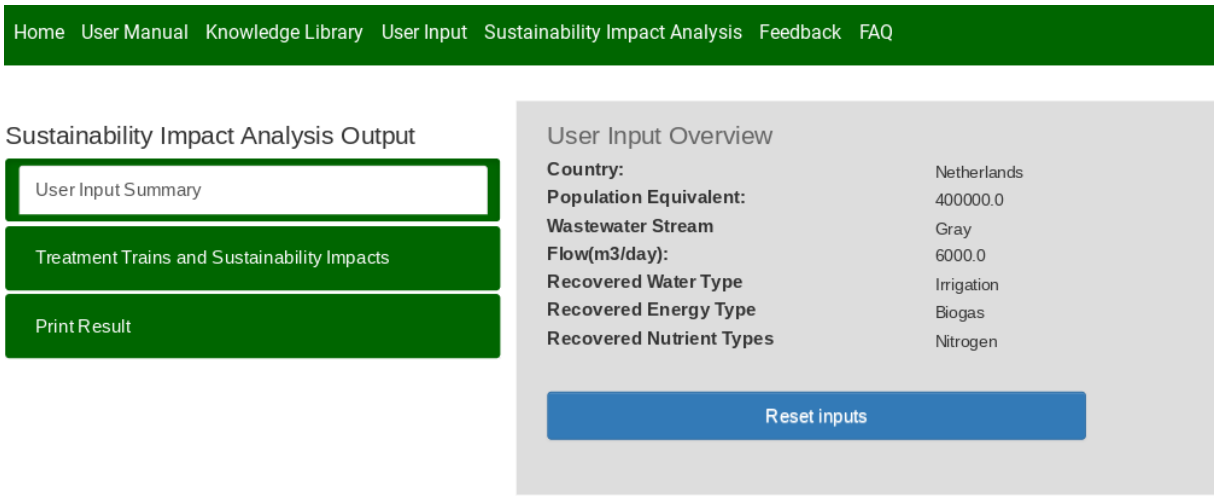

Figure 11: Input Summary Display

The first thing on the output section is a review of the inputs used in the analysis. If the user is unhappy they can go back, change these values, and then re-run the DST.

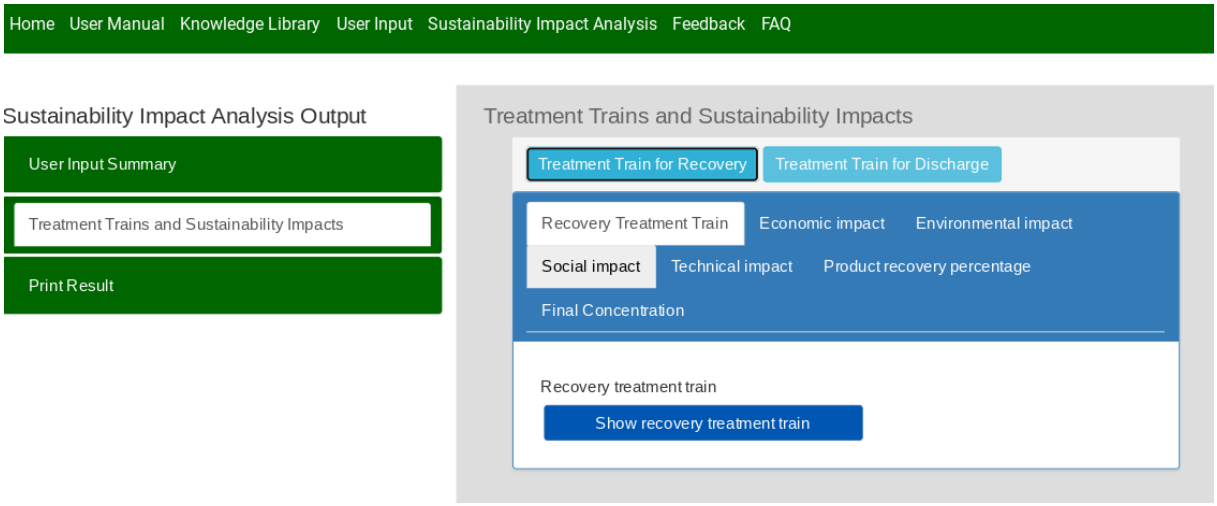

Figure 12: Sustainability Impact Recovery Analysis

Clicking the show recovery treatment train opens a new window window with a diagram of the treatment train, as seen in Figure 13.

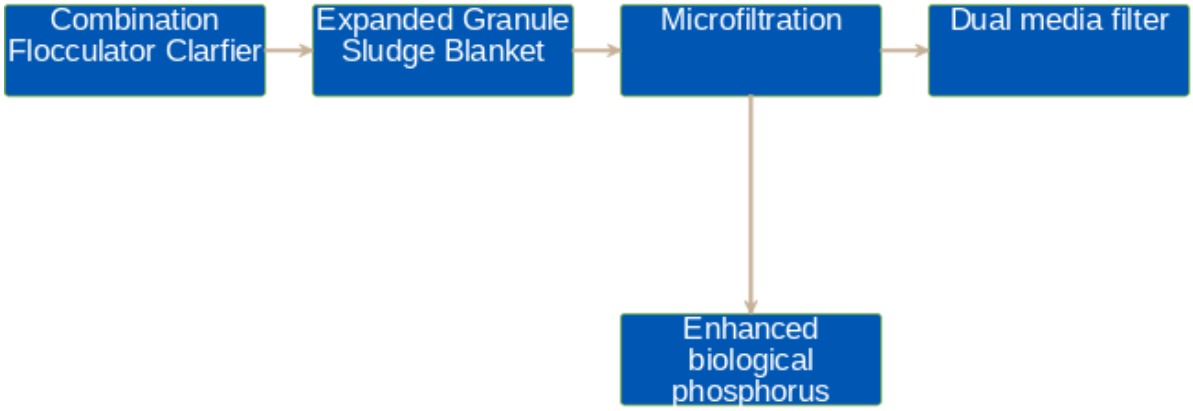

Figure 13: Example Treatment Train

Figure 12 shows the options for the recovery treatment train, which provides measure for the following impacts:

1. Economic Impact
2. Environment Impact
3. Social Impact
4. Technical Impact

5. Product Recovery Percentage
6. Final Concentration

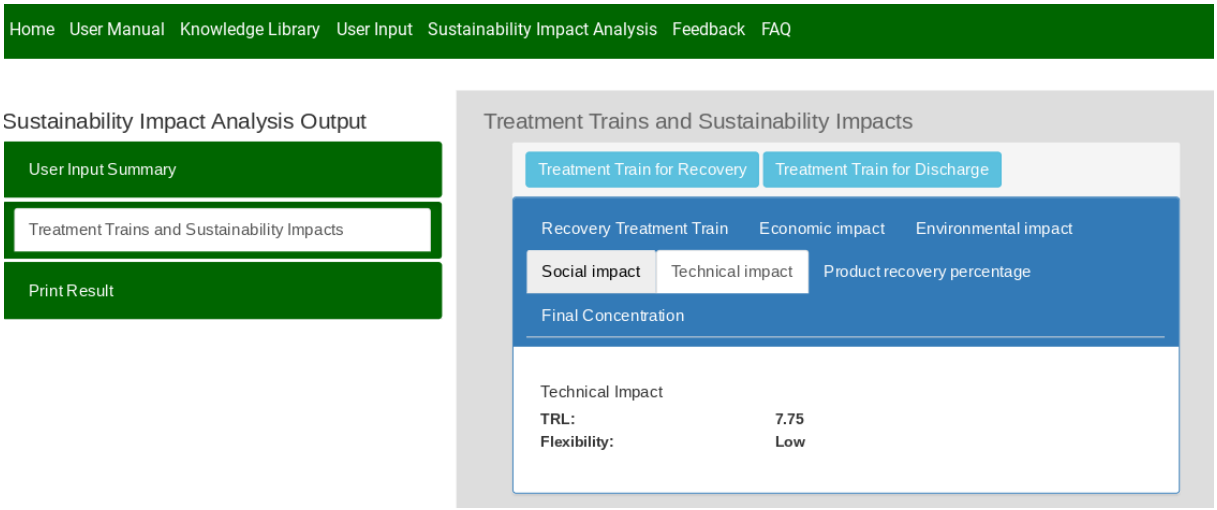

Figure 14: Technical Impact Values

Figure 14 shows, as an example, what you see when you select the Technical Impact tab. The user is provided with the outputs for the 2 technical sub-dimensions resulting from running the DST.

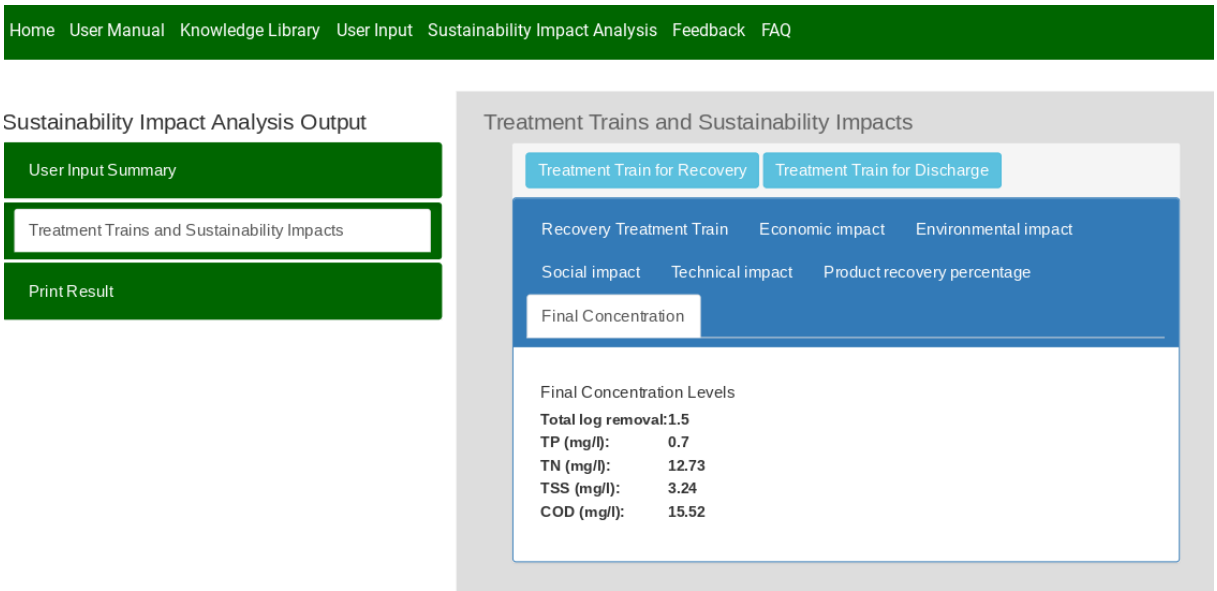

Figure 15: Final Concentration Values

Figure 15 shows the final concentration values obtained from an example test run.

4.2 Treatment Train for Discharge

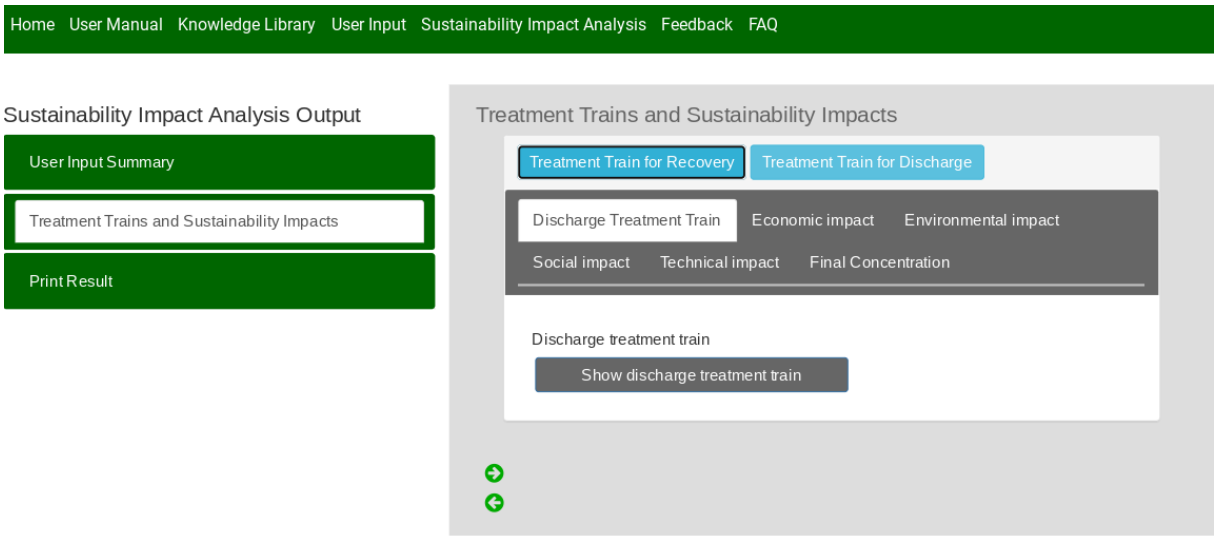

Figure 16: Sustainability Impact Discharge Analysis

The second options is for the discharge treatment train (no recovery), which provides measure for the following impacts:

1. Economic Impact
2. Environment Impact
3. Social Impact
4. Technical Impact
5. Final Concentration

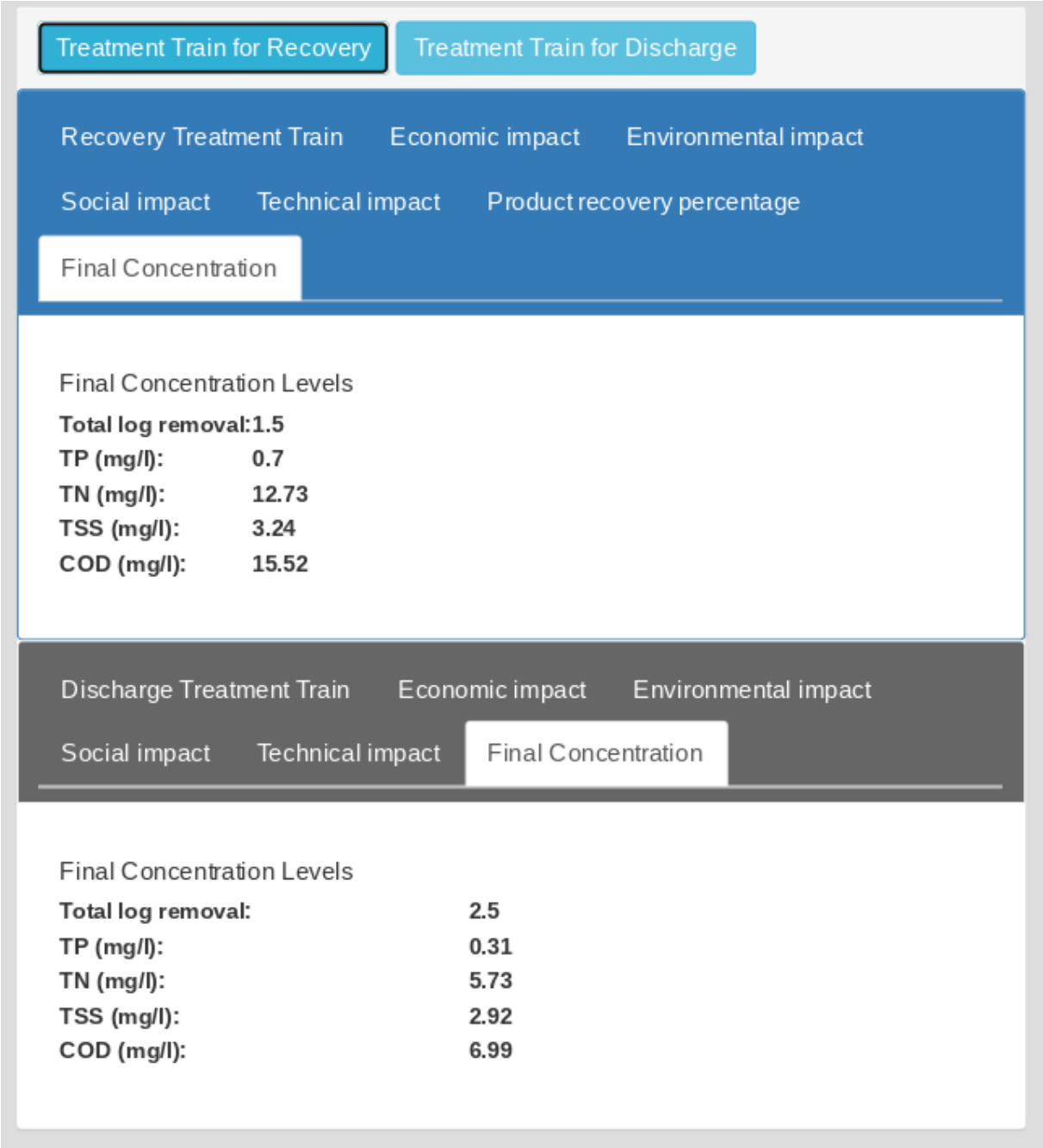

Figure 17: Final Concentration Values for Discharge

As can be seen in Figure 17 this provides similar styled output to the Treatment Train for Recovery analysis.

4.3 Print Output

The final option for the DST output provides the ability to simply observe all the available output values. This includes printing the input summary and viewing everything accessible through the tabs seen in Figure 12 on a single screen.

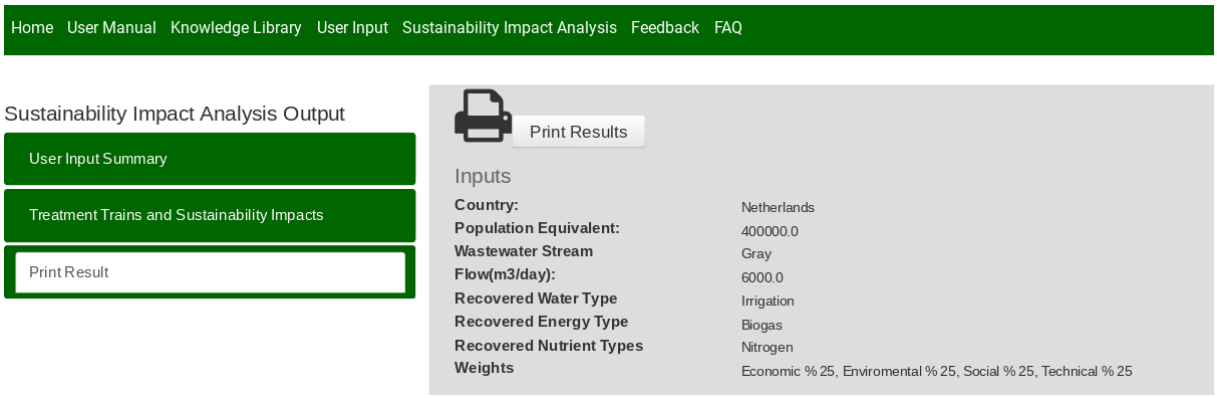

Figure 18: Print Results - Inputs

Feedback & Contact

The final sections shown on the homepage in Figure 1 are links to a feedback form and answers to Frequently Asked Questions. If you have any feedback please provide it so we can populate the frequent questions section with responses.

For any queries about the NEREUS Decision Support Tool or this User Manual contact: `kevin.willis@port.ac.uk`