DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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D23.1 SYSTEM REQUIREMENT SPECIFICATION AND SYSTEM DESIGN DOCUMENTS

Requirement elicitation and system design

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D23.1: System requirement specification and system design documents
Requirement elicitation and system design

SUMMARY

The overall goal of the DESSIN ESS software system is to support users implementing the DESSIN ESS evaluation framework and sustainability assessment, as described in the DESSIN Cookbook (D11.2). This document describes how the software should do this, from the end-user perspective.

The document is organized into so-called "user stories". Each user story describes a task that a user would like the software to perform, and explains why performing the task provides value to the user.

The users stories are organized into "epics", which are groups of similar stories. There are five epics, one for each of the five parts of the DESSIN Cookbook (D11.2).

Most of the user stories are written from the perspective of an evaluation lead carrying out an ESS assessment, as this was thought to be the most likely user of the system.

The software framework presented here was developed by DHI, ECOLOGIC, SINTEF, and IWW in collaboration with the DESSIN user group, which consists of the demo site representatives who will be the end users of the software.

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List of Acronyms and Abbreviations

CBA	Cost Benefit Analysis
CICES	Common International Classification System for Ecosystem Services
CP	Contingent Programming
CSO	Combined Sewer Overflow
DPSIR	Drivers, Pressures, States, Impacts, Responses
ESS	Ecosystem Services
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GVA	Gross Value Added
MCDA	Multi-Criteria Decision Analysis
NPV	Net Present Value
NUTS	Nomenclature of Territorial Units for Statistics
SA	Sustainability Assessment
SME	Small- or Medium-sized Enterprise

Executive summary

The overall goal of the DESSIN ESS software system is to support users implementing the DESSIN ESS evaluation framework and sustainability assessment, as described in the DESSIN Cookbook (D11.2). This document describes how the software should do this, from the end-user perspective.

The document is organized into so-called “user stories”. Each user story describes a task that a user would like the software to perform, and explains why performing the task provides value to the user. User stories are accompanied by acceptance criteria that define when a story is complete.

The users stories are organized into “epics”, which are groups of similar stories. There are five epics, one for each of the five parts of the DESSIN Cookbook (D11.2). There is not a one-to-one correspondence between the user stories and the “steps” of the cookbook because some steps were too complex to fit into a single coherent user story.

A number of potential user types were considered in the development of the user stories presented here, from scientists to SME representatives to technical specialists with computer programming expertise. However, most of the user stories are written from the perspective of an evaluation lead carrying out an ESS assessment, as this was thought to be the most likely user of the system.

The software framework presented here was developed by DHI, ECOLOGIC, SINTEF, and IWW in collaboration with the DESSIN user group, which consists of the demo site representatives who will be the end users of the software. Although the software is targeted to this user group, it is hoped that the software will go on to be used by others performing ESS and sustainability assessments after the conclusion of DESSIN.

1 Introduction

1.1 Purpose

This document describes what the DESSIN ESS software valuation software should do, from the end-user perspective. The purpose of the document is not to provide technical details for the software implementation, but rather to outline what the software should be able to do, and how the software should appear. The software requirements presented here are the result of consultations with individuals involved in developing the DESSIN ESS and sustainability assessment methodologies developed as part of DESSIN work package 11. In addition, the software requirements were refined through consultation with the end-users of the software (i.e., representatives of the DESSIN demo sites).

1.2 User stories

This document presents software requirements in a series of “user stories”. Each user story describes a task that a user would like the software to perform. In addition, each user story explains why performing the task provides value to the user. A simple example of a user story is provided below:

”As a registered customer I want to be able to order an item, so that I can buy and receive what I want.”

Note that the example states what the user would like to do (“order and item”) and why the user would like to do it (“receive what I want”).

User stories are accompanied by “acceptance criteria”, which outline what the functionality described in the story should be able to do when implementation is complete. In other words, acceptance criteria describe when a user story is complete.

In this document, user stories are organized into “epics”, which group similar stories. Together, the different epics support the overall goals of the software system. A conceptual diagram of the organizational structure is provided in Figure 1.

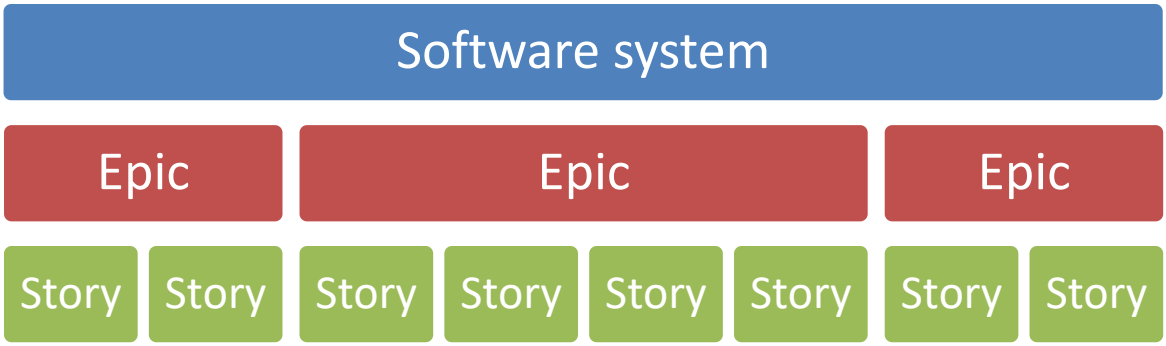

Figure 1 Organizational structure of software system

1.3 Organization of the software system

1.3.1 Overall goal

The overall goal of the software system is to support users implementing the DESSIN ESS evaluation framework and sustainability assessment, as described in the DESSIN Cookbook (D11.2).

1.3.2 Epics

The software user stories are organized into five epics, one for each part of the cookbook:

1. Study description
2. Problem characterization
3. Description of Responses and identification of potential Beneficiaries
4. Impact evaluation
5. Sustainability assessment

1.3.3 User stories

The user stories represent the different tasks that should be carried out to implement the methodology in the DESSIN Cookbook (D11.2). There is not a one-to-one correspondence between the user stories and the "steps" of the cookbook because some steps were too complex to fit into a single coherent user story.

1.4 Potential users of the software

As part of the development of user stories, the WP23 partners identified potential users of the software. All of the user stories are written from the perspective of one or more of these users. A list of user profiles and a brief description of each user is provided in Table 1. Most of the user stories presented in this document are written from the perspective of the evaluation lead, as it was thought this profile is representative of the most likely user of the software.

Table 1 User profiles

ID	User	Description
Evaluation lead	Scientist/Planner	This person leads ESS and sustainability assessments to provide information and advice to decision-makers.
Domain expert	Scientist	This person has "domain knowledge" and provides scientific support to the Evaluation lead.
SME	SME representative	This person has knowledge of proposed technologies and is interested in using an ESS assessment to showcase the value of adopting technologies.

Techie	Engineer/Programmer	This person is capable of using the full MIKE Workbench system and provides technical support to the other users.

1.5 Prioritization of user stories

Because resources available to the DESSIN project do not allow for implementation of all of the user stories described in the document, it is also necessary to prioritize. A “must/should/could” prioritization scheme is used, in which the following prioritization levels are defined:

- **Must:** Stories labeled as “must” are stories that must be included in the Final solution. Not including these stories would mean that software is not fulfilling its purpose. All stories labeled as “must” will be implemented in the final version of the software tool (D23.2).
- **Should:** Stories labeled as “should” are stories that should be included if possible. These stories are not essential for fulfilling the purpose of the software; however, not including them may force users to undertake time-consuming work-arounds. All stories labeled as “should” will be implemented in the software tool if resources are available after implementation of the stories labeled as “must”.
- **Could:** Stores labeled as “could” are stories that are considered desirable but not necessary. These stories are not essential for fulfilling the purpose of the software, and work-arounds are relatively easy. All stories labeled as “could” will be implemented in the software tool if resources are available after implementation of the stories labeled as “must” and “should”.

User stories are also given an estimate of the level of effort required to implement each story.

2 Epic 1: Study description

The purpose of the first epic is to prepare the evaluation by delineating general basic characteristics of the study area including: the geographical location and spatial extension; the intended audience and expected results of the assessment; and to gather economic and demographic information.

2.1 Epic 1: User stories

User stories for Epic 1 are presented in Table 2.

Table 2 Epic 1: User stories

Id	Title	Story	Acceptance criteria	Importance (Must/should/could)	Estimate (Small/Medium/Large)
1.1	Insert general information about the assessment	As Evaluation lead or SME, I would like to declare what the objective of the assessment is; who the intended audience of the results is; who the entities involved in carrying out the assessment are; who the providers of information for the assessment are; and who the providers of funding for the assessment are in order to ensure transparency and avoid conflict of interest.	The software should be able to provide a separate entry possibility for text describing the: i) objective of the assessment; ii) target audience; iii) entities carrying out the assessment; iv) entities providing information for the assessment; v) entities funding the assessment vi) list of stakeholders	Must	Small
1.2	Delineate system boundary	As an Evaluation lead or SME, I would like to delineate the boundaries of the system of interest in order to limit the scope of the exercise.	The software must provide the possibility of entering information on the geographical location and spatial extension of the study area. The user is prompted to select from a list of Eurostat-defined geographical areas.	Could	Medium

1.3	Collect population data for the system	As an Evaluation lead or SME I would like to get an overview of the population level and population density within the study area in order to facilitate the later analysis of drivers and pressures.	The user is able to download population and density data from Eurostat for the region selected in 1.3. The user is only able to download data for the most recent year available (2014). Population: • Dataset Title: Population on 1 January by broad age group, sex and NUTS 3region • Dataset Code: demo_r_pjanaggr3 • On the Eurostat database (http://ec.europa.eu/eurostat/data/database) go to Database by themes > Population and Social Conditions > Population (demo_pop) > Regional data (demopreg) > Population on 1 January by broad age group, sex and NUTS 3 region (demo_r_pjanaggr3) • Metadata can be found at: http://ec.europa.eu/eurostat/cache/metadata/en/demo_r_gind3_esms.htm Density: • Dataset Title: Population density by NUTS 3 region • Dataset Code: demo_r_d3dens • On the Eurostat database (http://ec.europa.eu/eurostat/data/database) go to Database by themes > Population and Social Conditions > Population (demo_pop) > Regional data (demopreg) > Population density by NUTS 3 region (demo_r_d3dens) • Metadata can be found at: http://ec.europa.eu/eurostat/cache/metadata/en/demo_r_gind3_esms.htm	Could	Large
1.4	Collect information about economic activities	As Evaluation lead, I would like to get an overview of the economic activities in my study area to facilitate the later analysis of drivers and pressures.	The user is able to download GVA data from Eurostat for the region selected in 1.3. The user is only able to download data for the most recent year available (2014). • Dataset Title: Gross value added at basic prices by NUTS 3 regions • Dataset code: nama_10r_3gva • On the Eurostat database (http://ec.europa.eu/eurostat/data/database) go to Database by themes > Economy and finance > National accounts (ESA 2010) (na10) > Regional economic accounts - ESA2010 (nama_10reg) > Branch accounts - ESA2010 (nama_10r_brch) > Gross value added at basic prices by NUTS 3 regions (nama_10r_3gva) The user is able to download employment data from Eurostat for the region selected in 1.3. The user is only able to download data for the most recent year available (2014).	Could	Large

			• Dataset Title: Employment (thousand persons) by NUTS 3 regions • Dataset code: nama_10r_3empers • On the Eurostat database (http://ec.europa.eu/eurostat/data/database) go to Database by themes > Economy and finance > National accounts (ESA 2010) (na10) > Regional economic accounts - ESA2010 (nama_10reg) > Branch accounts - ESA2010 (nama_10r_brch) > Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers)		
1.5	General guidance	As an Evaluation lead or SME, I would like to have guidance on which information should be provided in order to reduce time spent on the initial assessment.	Each text entry possibility should offer some links to information sources. The links should be to datasets that cover all of Europe with appropriate local-scale detail. The links are the same as the links defined in 1.3 and 1.4. This can be an alternative solution if 1.3 and 1.4 cannot be implemented because of resource constraints. Each text entry possibility should offer some guidance on what should be entered. The user should be able to hover over the text fields and something like column 3 in Table 1 from the DESSIN Cookbook (D11.2) should appear. I would like a separate entry possibility for text describing each characteristic needed to provide an overview of the study area. Refer to Table 1, row 3 of Cookbook for complete list.	Must	Small

2.2 Epic 1: Storyboard

This section presents mock-ups of the visual appearance of the stories outlined in Epic 1.

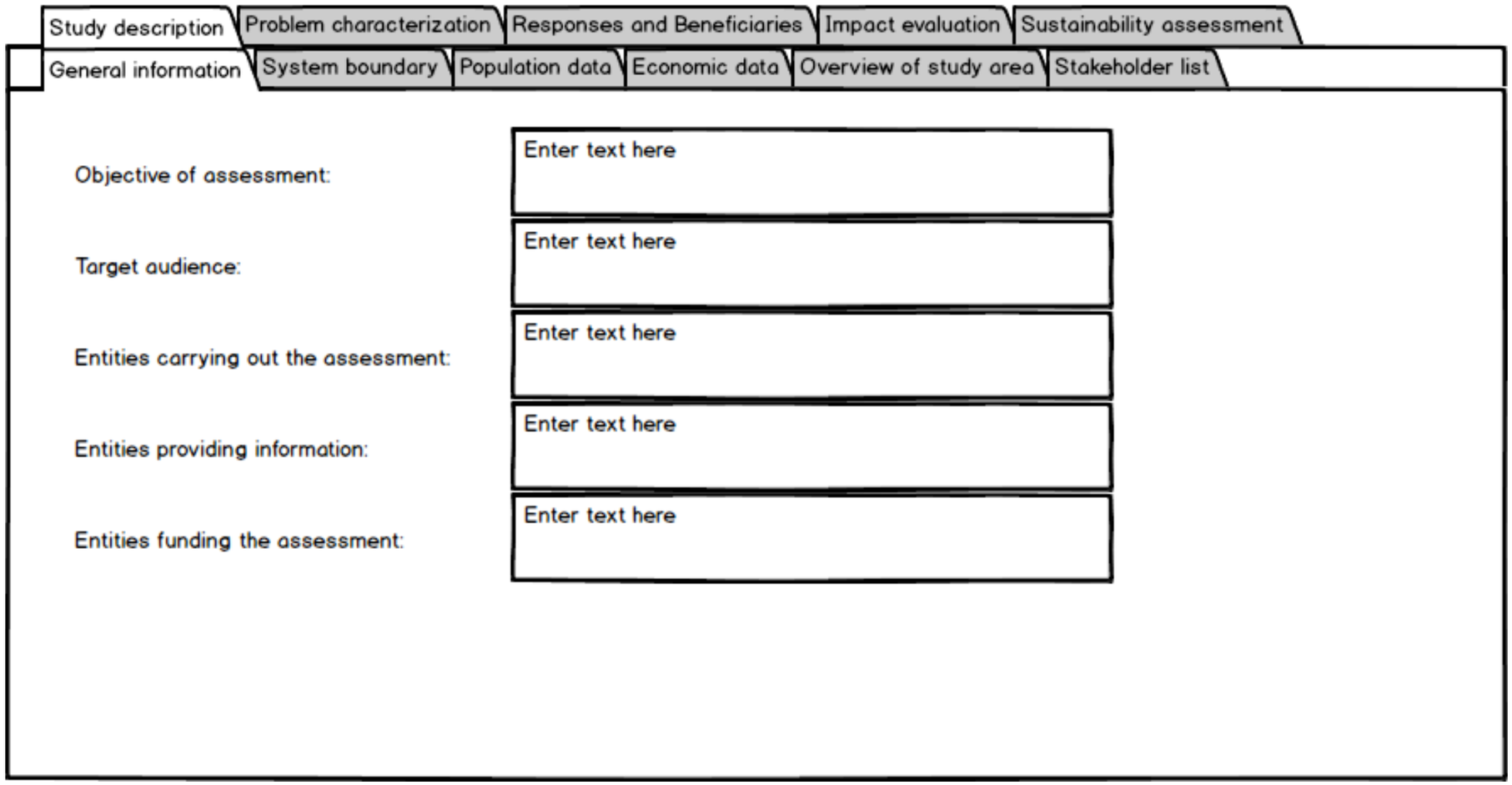

Figure 2 User story 1.1: Insert general information about the assessment

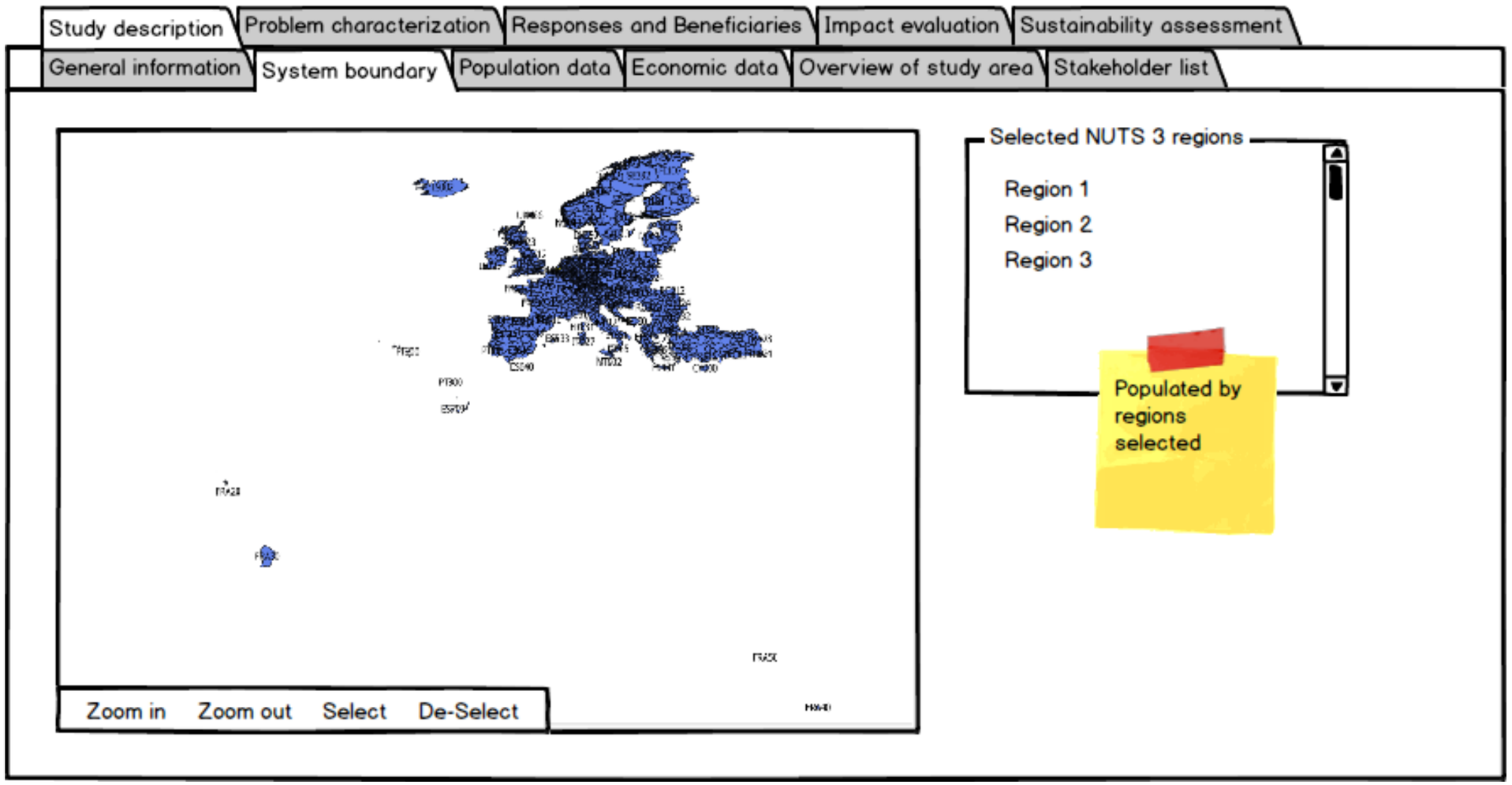

Figure 3 User story 1.2: Delineate system boundary

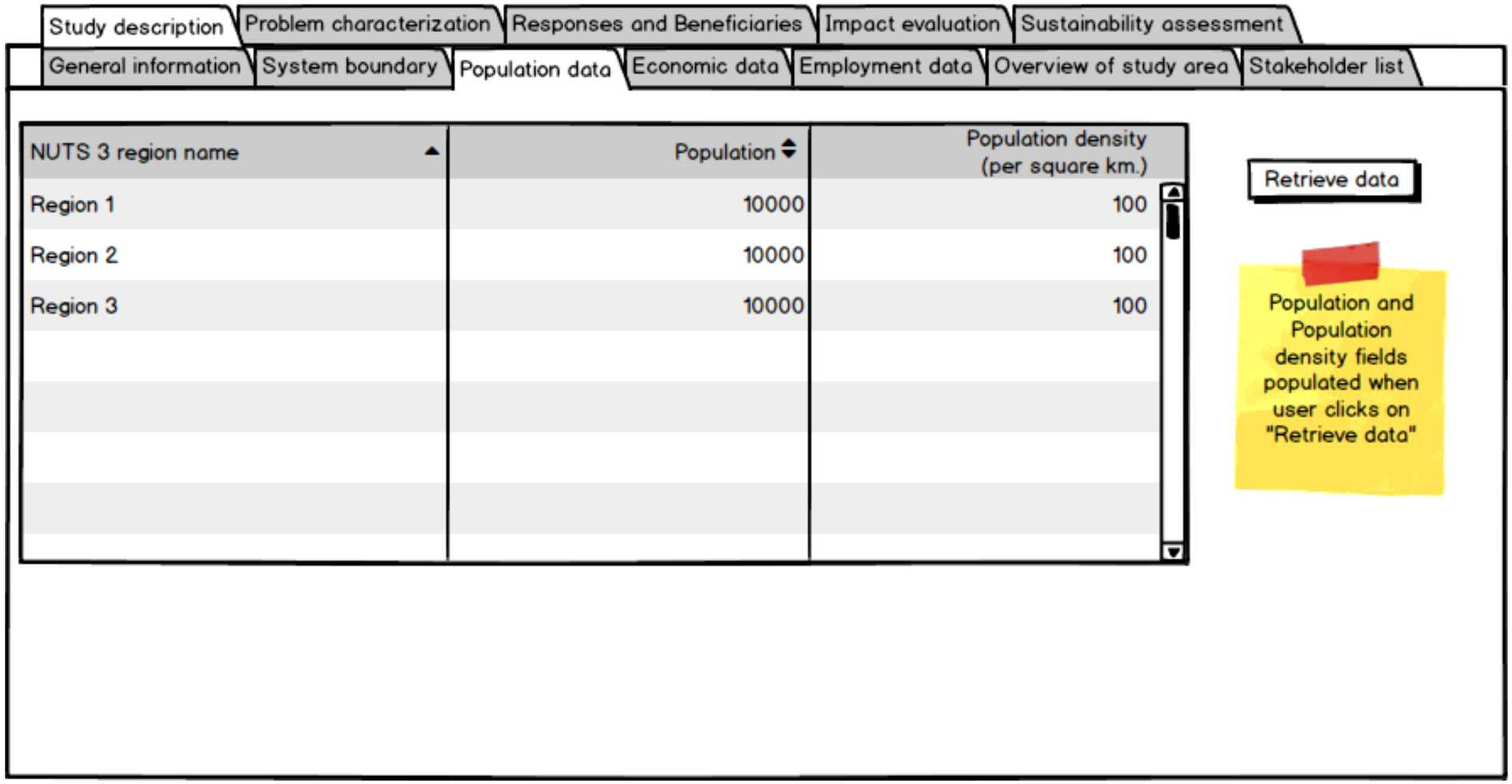

Figure 4 User story 1.3: Collect population data for the system

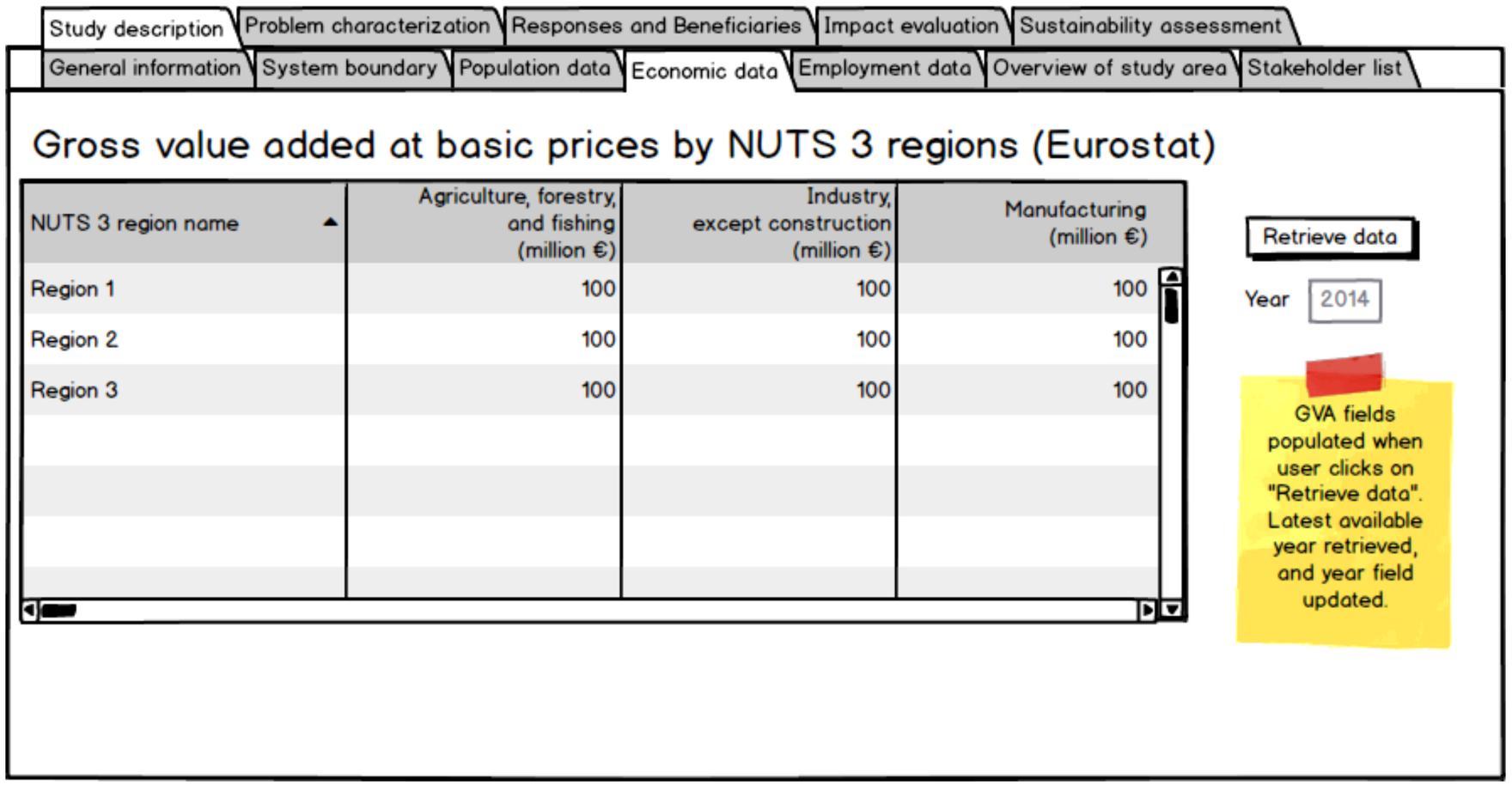

Figure 5 User story 1.4: Collect information about economic activities

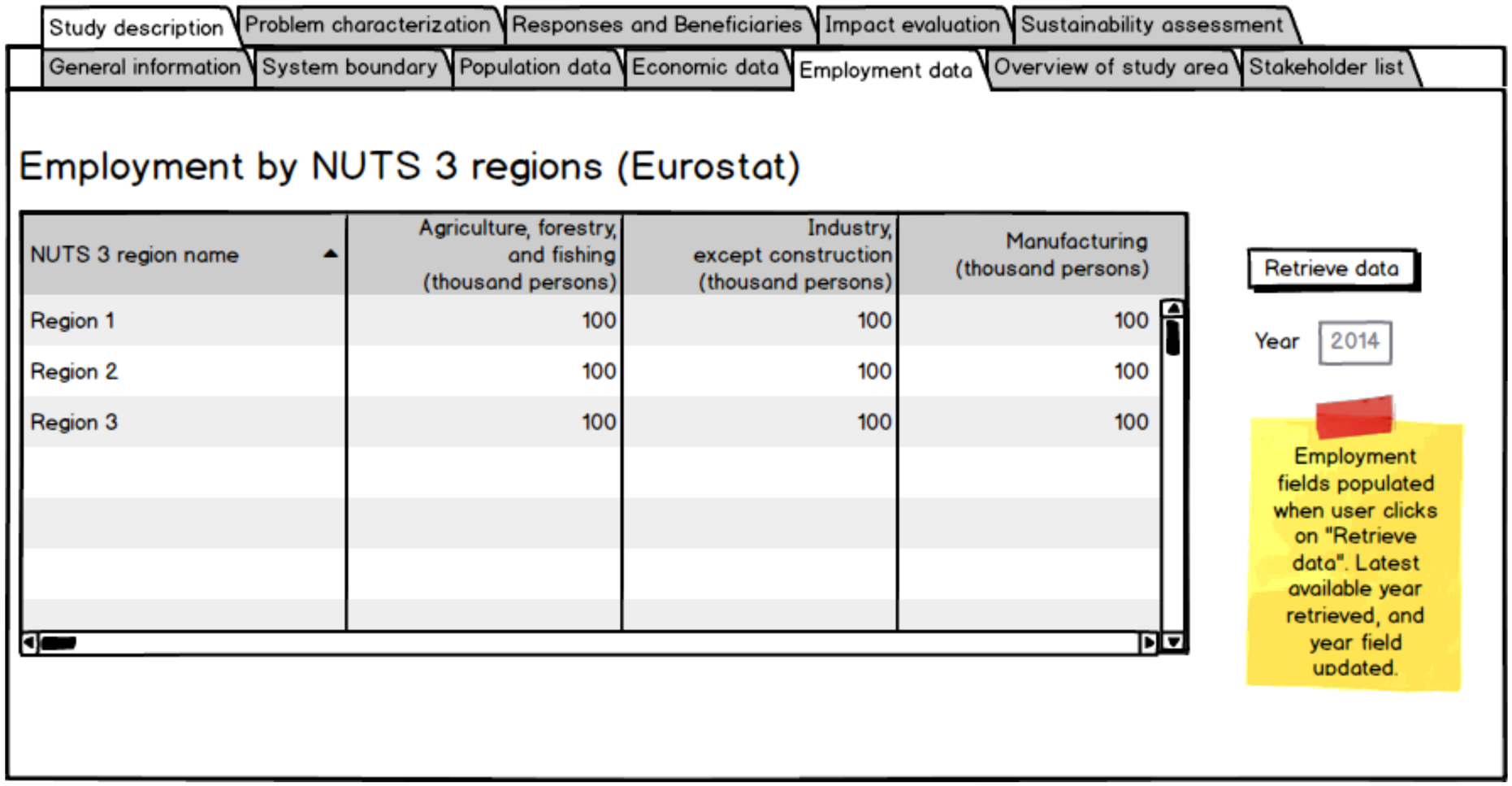

Figure 6 User story 1.4: Collect information about economic activities

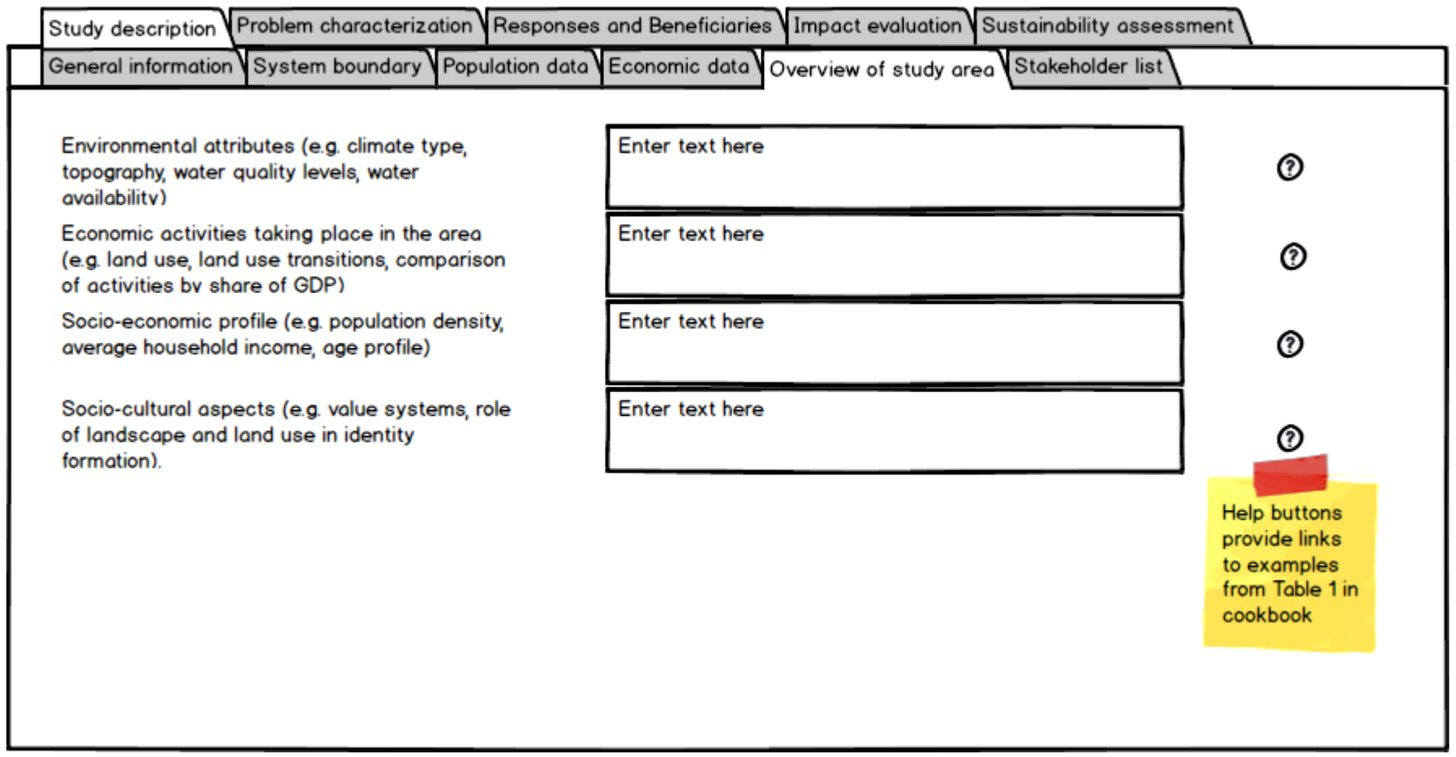

Figure 7 User story 1.5: General guidance

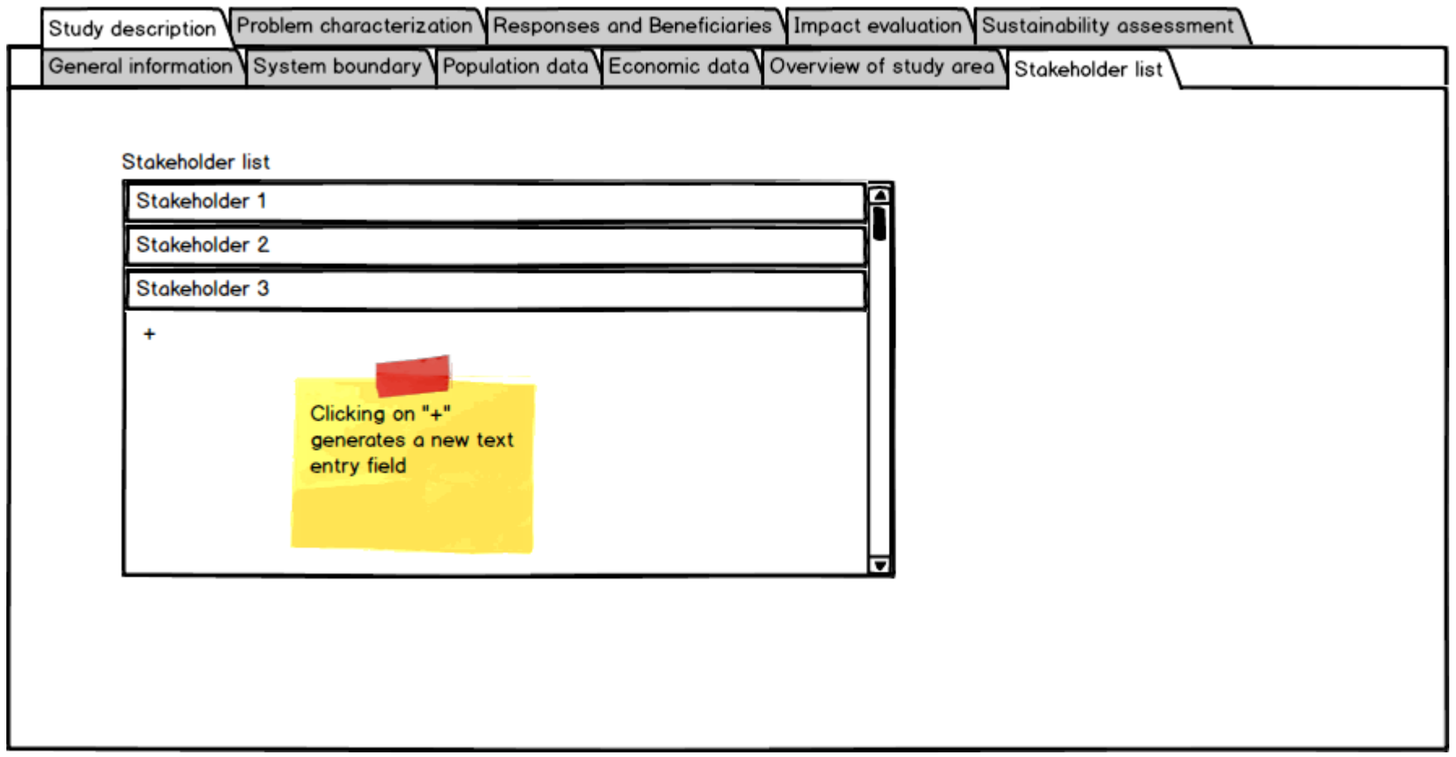

Figure 8 User story 1.1: Stakeholder list

3 Epic 2: Problem characterization

Epic 2 represents the first step in the core evaluation and is the entry point towards describing the entire DPSIR cycle. Here the relevant Drivers and Pressures are identified in order to understand the full picture of the system under study. This enables the user to decide which Pressures to focus the rest of the evaluation on, and provides initial insight on what appropriate measures could be.

The purpose of this epic is to produce a qualitative overview of the Drivers present in the study area, relate these to resulting Pressures, and describe the latter. As a rule within the DESSIN assessments, Pressures should be described qualitatively. In specific cases where the proposed measures are expected/found to influence Pressures, then changes in those Pressures should be quantified.

3.1 Epic 2: User stories

User stories for Epic 2 are presented in Table 3.

Table 3 Epic 2: User stories

Id	Title	Story	Acceptance criteria	Importance (Must/should/could)	Estimate (Small/Medium/Large)
2.1	Select case-relevant drivers	As an Evaluation lead or SME, I want to be presented with a list of drivers so that I can choose the ones that are relevant for my study area.	The list of drivers in the DESSIN Cookbook (D11.2) is available to the user. The user selects from the list and is prompted to enter a specification for each selected driver. A specification is made by entering text in a text field.	Must	Small
2.2	Insert additional drivers	As an Evaluation lead or SME, I want to be able to insert additional driver types that I have found to be present in my study area but are not included in the DESSIN catalogue in order to ensure I have an exhaustive list.	The software should provide the possibility of entering additional driver types as text. The user should then be prompted to enter a specification for each additional driver.	Must	Small
2.3	Add specifications for case-relevant drivers	As an Evaluation lead or SME, I want to provide more information about drivers to help me select pressures in the pressures step.	The user must provide a specification about each case-relevant driver. The user is provided with examples from the mature sites. The user receives a message to consider using information from Part I – Study description (e.g. economic activities found to be taking place in the study area).	Must	Small

2.4	Identify associated pressures	As an Evaluation lead or SME, I want to be presented with a list of pressures related to each driver selected in 2.1 so I can choose the ones relevant in my study area.	A list of associated pressure categories is generated for each driver. The user is presented with the list and is prompted to select those relevant in the study area and enter a specification for each selected pressure. For those additional drivers that were inserted by the user in 2.2, the software should present the full list of pressure categories for the user to associate the additional drivers to one or more resulting pressures.	Must	Small
2.5	Select case-relevant pressures	As a domain expert, I want to be presented with data that can help me identify which pressure categories from the subset generated above are relevant in my study area.	The user is presented with Table 2 of the DESSIN Cookbook (D11.2). Based on a review of the information, the user selects case-relevant pressures.	Must	Small
2.6	Insert additional pressures	As a domain expert, I want to be able to insert additional pressure types that I have found to be present in my study area but are not included in the DESSIN catalogue in order to ensure I have an exhaustive list.	The software should provide the possibility of entering additional pressure types as text. The user should then be prompted to enter a specification for each additional pressure. The user is prompted to associate the new pressure to the list of drivers.	Must	Small
2.7	Provide a specification for each of the case-relevant pressures	As a domain expert, I want to provide more information about case-relevant pressures to facilitate the later analysis of Responses.	The user must provide a specification for each case-relevant pressure. The user is provided with examples from the mature sites. The user is prompted to use information from Part I – Study description (e.g. economic activities found to be taking place in the study area). The software should provide the possibility of navigating back to this screen from the response analysis screen in order to include additional quantitative information to the description of case-relevant pressures.	Must	Small

3.2 Epic 2: Storyboard

This section presents mock-ups of the visual appearance of the stories outlined in Epic 2.

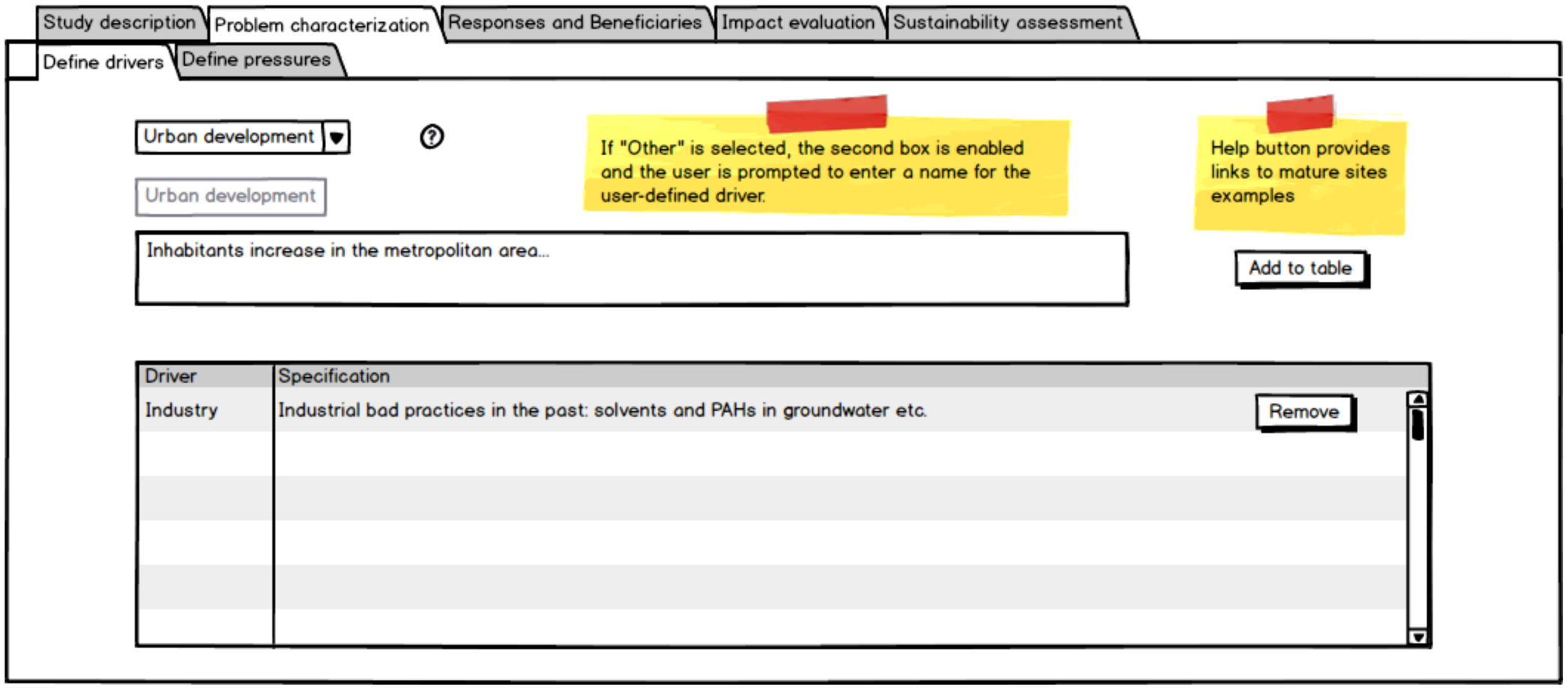

Figure 9 User stories 2.1-2.3: Select case-relevant drivers, Insert additional drivers, Add specifications for case-relevant drivers

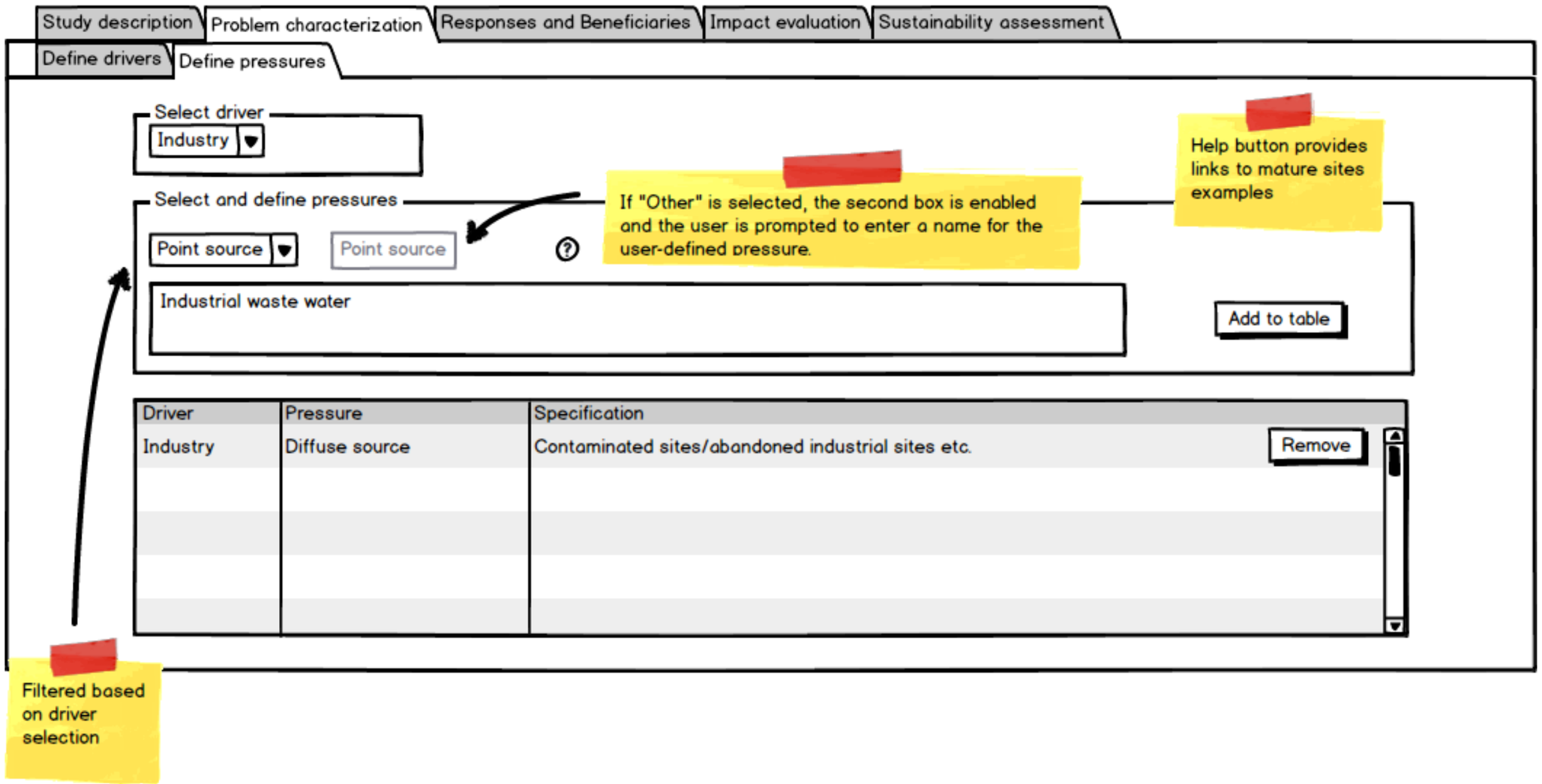

Figure 10 User stories 2.4-2.7: Identify associated pressures, Select case-relevant pressures, Insert additional pressures, provide a specification for each of the case-relevant pressures

4 Epic 3: Description of Responses and identification of potential Beneficiaries

Epic 3 describe the Responses (i.e. the proposed measures) that can be implemented to address the problems in the study area, as identified in Part II. It also aims to identify the case-relevant ESS (i.e. the ESS hypothetically affected by the proposed measure). Finally, ESS are linked to Beneficiaries, and this information is used to categorize the case-relevant ESS as Final ESS or Intermediate ESS.

4.1 Epic 3: User stories

User stories for Epic 3 are presented in Table 4.

Table 4 Epic 3: User stories

Id	Title	Story	Acceptance criteria	Importance (Must/should/could)	Estimate (Small/Medium/Large)
3.1	Create a measure	As an Evaluation lead or SME, I want to create a new measure and specify its properties.	I can give the measure a title. I can select a type (technical or management). I can provide an expected lifetime that is known to the system in a number format.	Must	Small
3.2	Describe capabilities	As an Evaluation lead or SME, I want to state a claimed/expected capability of the proposed measure so that I can establish a link to changes in state.	I can provide a name in a text field. I can describe the capability qualitatively in a text field. I can describe if the capabilities are theoretical or tested.	Must	Small
3.3	Select affected drivers	As an Evaluation lead, domain expert, or SME, I want to select drivers affected by the proposed measure if the measure is a management measure so I know whether I need to estimate impacts of changes to drivers on pressures.	I can select drivers from the list identified in part II. The list can include “none”.	Must	Small
3.4	Select affected pressures	As an Evaluation lead, domain expert, or SME, I want to select pressures affected by the proposed measure so that I know whether I need to quantify impacts on pressures.	I can select pressures from the list identified in part II. The list can include “none”.	Must	Small

3.5	Select affected state parameters	As an Evaluation lead, domain expert, or SME, I want to select state parameters affected by the proposed measure in order to obtain a list of case-relevant ESS.	I can select state parameters from the list on worksheet “State indicators” in the supplementary material file for each measure. The list is grouped using the same system that is used in the supplementary material file. I am able to read a definition of each state parameter.	Must	Small
3.6	Insert additional state parameters	As an Evaluation lead, domain expert, or SME, I want to input other state parameters affected by the proposed measure that are not included in the DESSIN catalogue in order to obtain an exhaustive list of case-relevant ESS.	I am able to enter the name of an additional state parameter. I am required to provide a description of the parameter.	Must	Small
3.7	Identify case-relevant ESS	As an Evaluation lead or SME, I want a list of case-relevant ESS so that I start the process of identifying Final ESS.	A list of case-relevant ESS is generated based on my selection in 3.5. The list is generated by the links provided in the State-Impact I Provision table in the supplementary material. The list consists of ESS classes in the CICES system. CICES section names are also provided. For each additional state parameter identified in 3.6, the user is provided with the full CICES list and prompted to select ESS classes affected by the additional state parameter. The software should provide text entry possibility to allow for a description of each case-relevant ESS that is more detailed than the CICES ESS class titles.	Must	Small
3.8	Identify beneficiary types	As an Evaluation lead, domain expert, or SME, I want a list of beneficiary types so that I can create a list of Beneficiaries.	For each case-relevant ESS, I select beneficiary types that benefit from that ESS. I select from the list given in column C of the worksheet DESSIN Beneficiaries-Final ESS in the supplementary material. The list also includes the information provided in columns D, E and F in order to assist me with the selection.	Must	Small
3.9	Identify Beneficiaries and classify ESS as Final or Intermediate	As an Evaluation lead or SME, I want to produce a list of Beneficiaries so that I can classify each of the case-relevant ESS as Final or Intermediate.	The software must allow the user to compare each entry in the stakeholder list created in Part I to each beneficiary type from the ones selected in 3.8 (i.e. the ones associated to each case-relevant ESS). The user must then assign a beneficiary type to each stakeholder in the study area. The choice can include “none”, as some stakeholders might not fall within any of the categories listed in the subset of beneficiary types. Each case-relevant ESS that has a beneficiary type that could be associated with a stakeholder is classified as Final. All others are classified as Intermediate.	Must	Small

3.10	Select ESS for further analysis	As an Evaluation lead or SME, I want a list of all Final and Intermediate ESS so that I can select ESS for further analysis.	I am presented with a list of case-relevant ESS classified as Final and Intermediate and select the ones that will be analysed further in Part IV.	Must	Small

4.2 Epic 3: Storyboard

This section presents mock-ups of the visual appearance of the stories outlined in Epic 3.

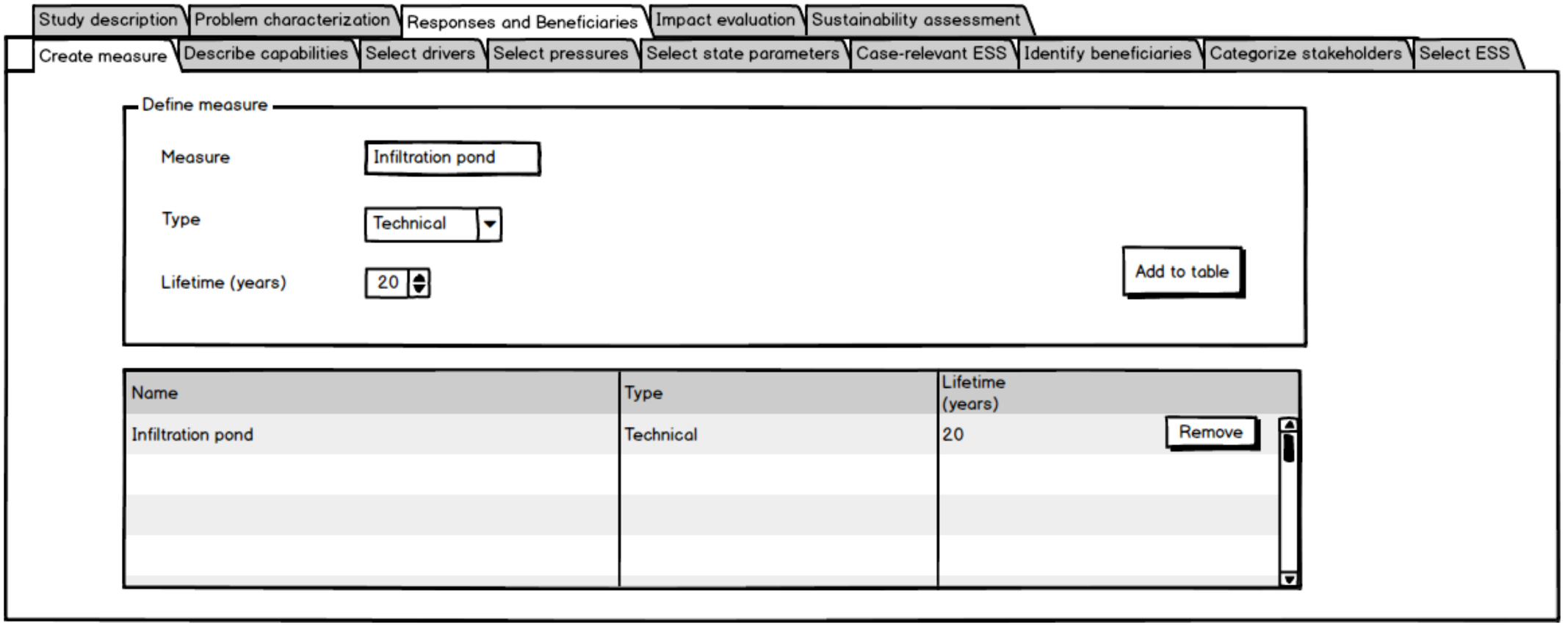

Figure 11 User story 3.1: Create a measure

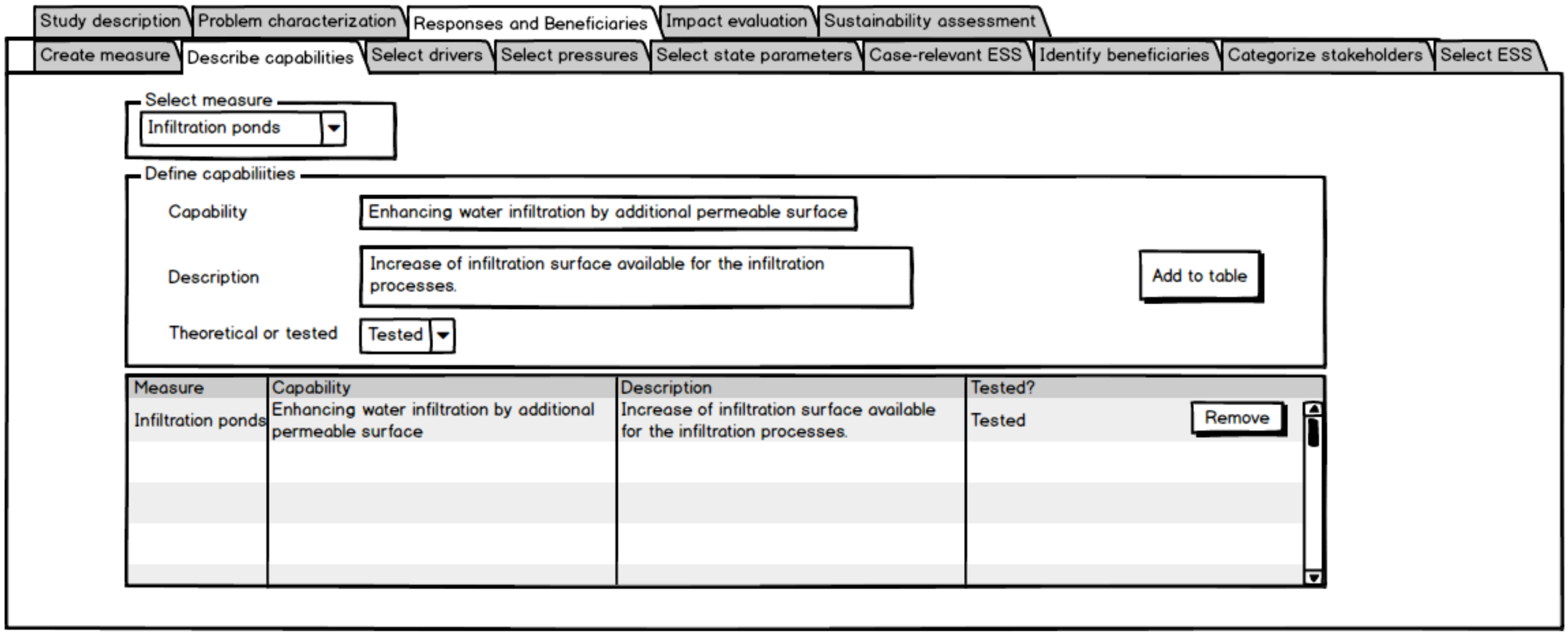

Figure 12 User story 3.2: Describe capabilities

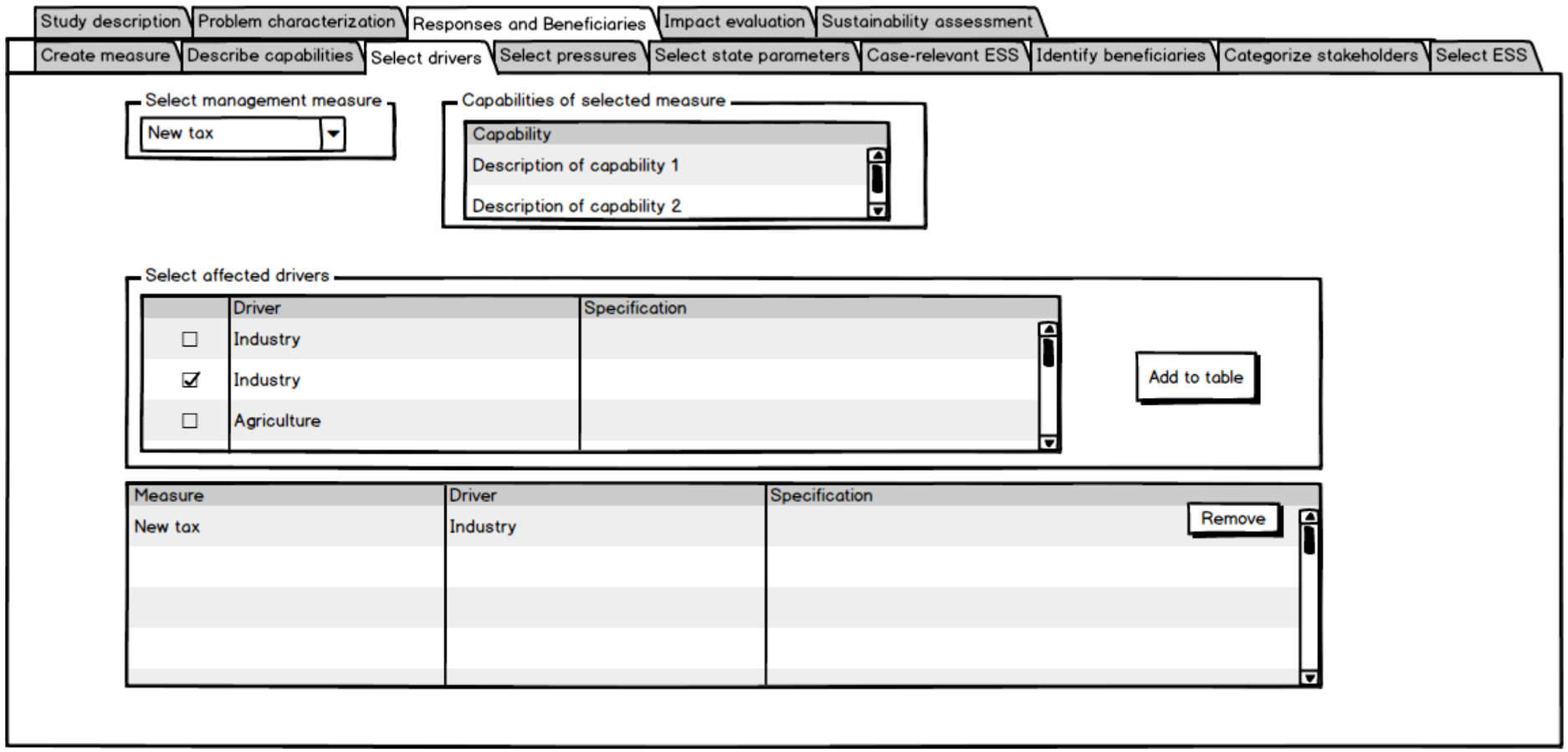

Figure 13 User story 3.3: Select affected drivers

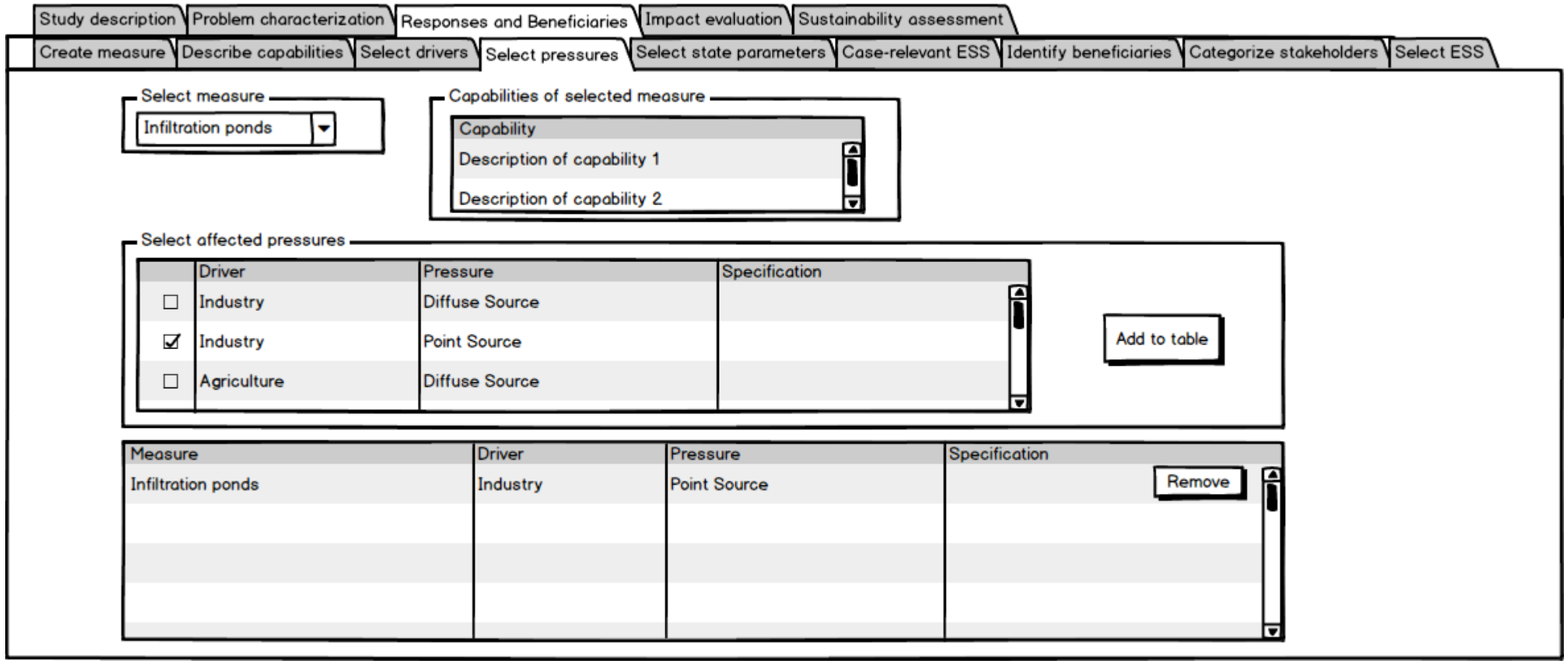

Figure 14 User story 3.4: Select affected pressures

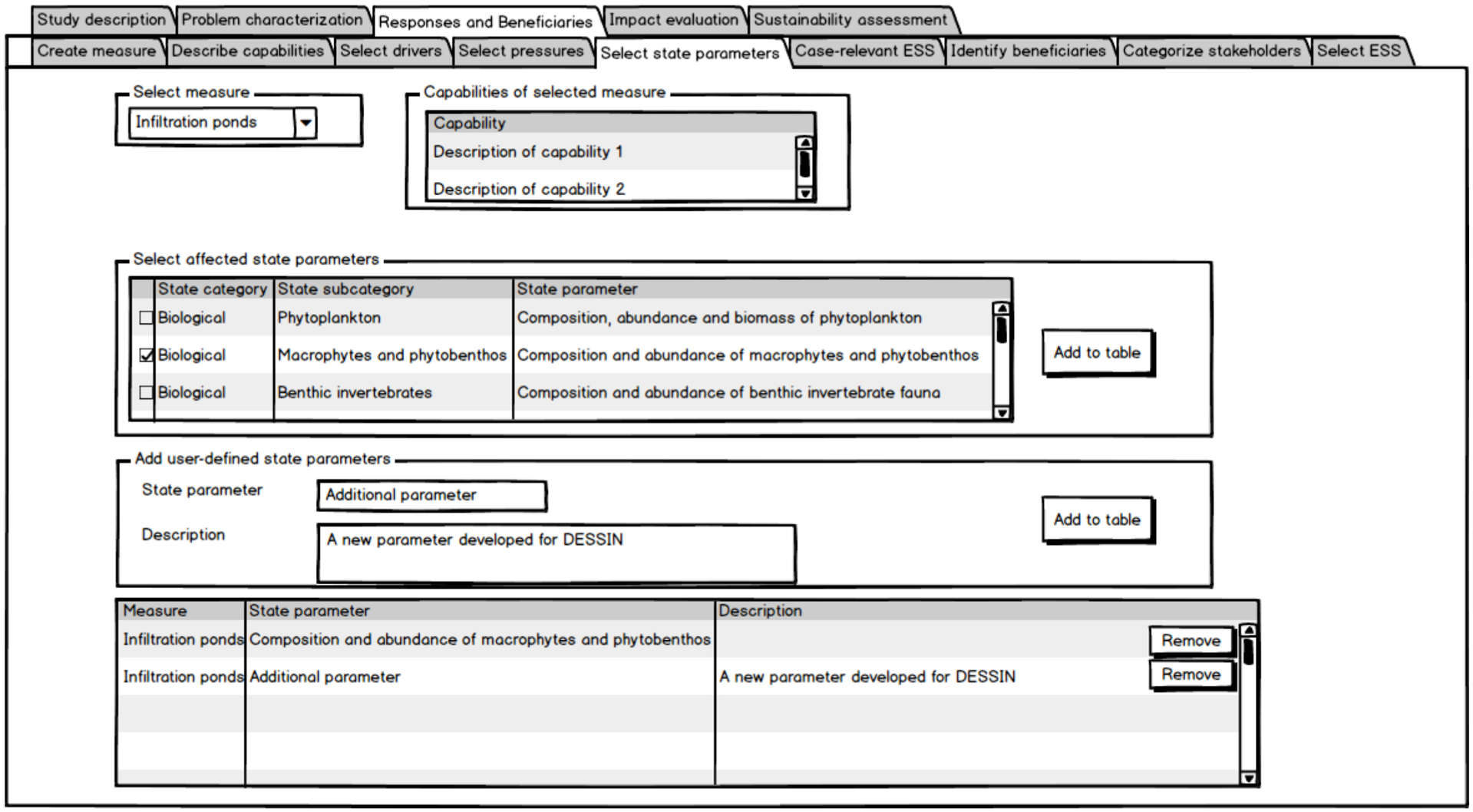

Figure 15 User stories 3.5-3.6: Select affected state parameters, Insert additional state parameters

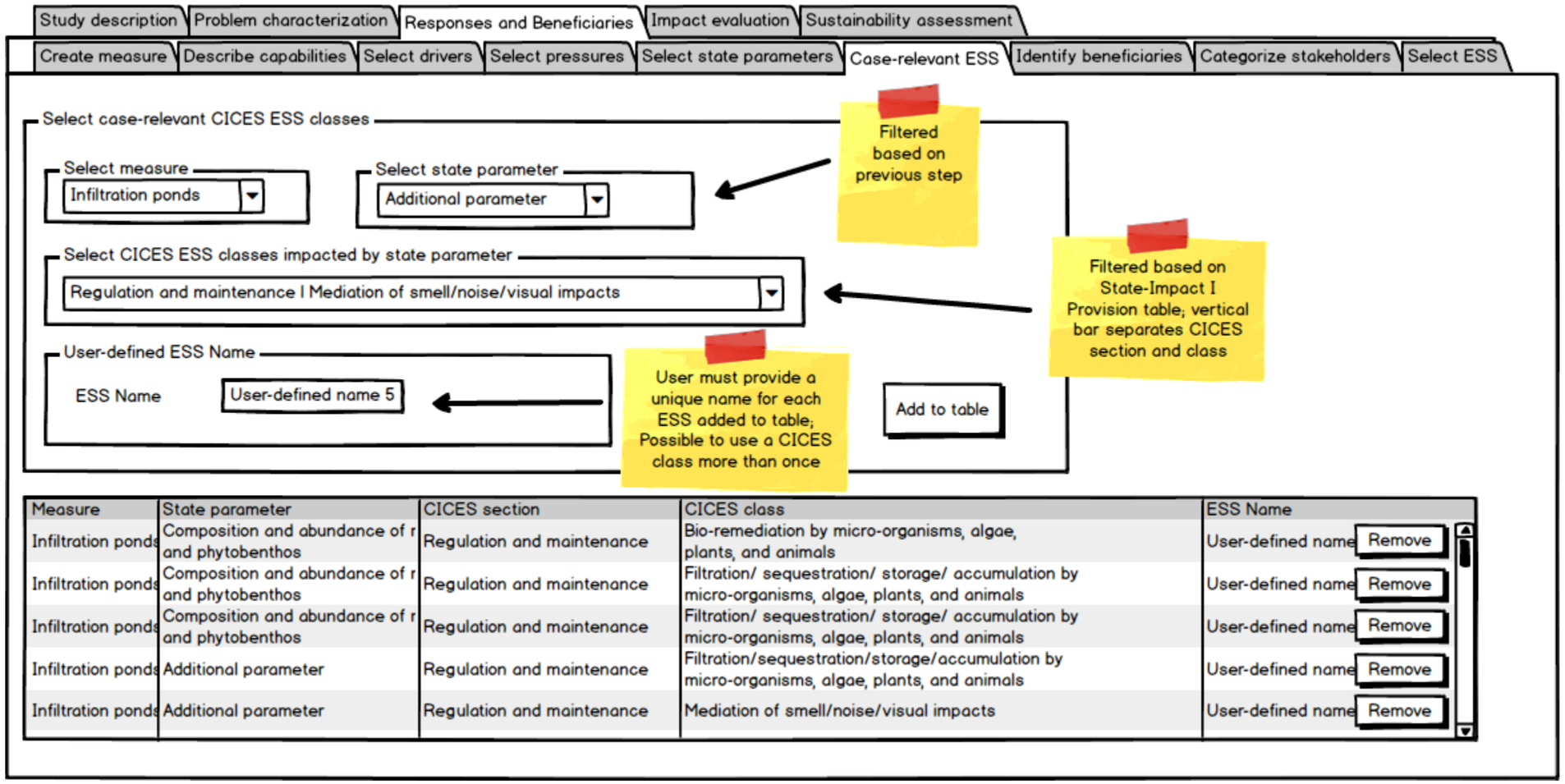

Figure 16 User story 3.7: Identify case-relevant ESS

Study description | Problem characterization | Responses and Beneficiaries | Impact evaluation | Sustainability assessment

Create measure | Describe capabilities | Select drivers | Select pressures | Select state parameters | Case-relevant ESS | Identify beneficiaries | Categorize stakeholders | Select ESS

Select case-relevant ESS

User-defined name 1 ▾ CICES section and class: Regulation and maintenance I Bio-remediation by micro-organisms, algae, plants, and animals

Select beneficiary types benefiting from Case-relevant ESS

	Main beneficiary type	Beneficiary sub-type (example)	Example of general beneficiary description (water focus)	Final ESS of relevance to the beneficiary
☐	None			
☑	Recreational	Experiencers and viewers	This beneficiary recreationally picks or gathers from the natural abundance of edible flora, fungi, and some fauna (as long as it is not fished or hunted). This beneficiary has potential contact with water.	opportunity to view the environment and organisms within it landscape that provides a sensory experience organisms (i.e., flowers, plants, etc.) that can be viewed organisms (i.e., birds, mam-mals, reptiles, etc.) that can be viewed sounds and scents that provide a sensory experience
☐	Recreational	Food pickers and gatherers	Toxics and other nuisances	Mediation by biota
☐	Recreational	Hunters	Toxics and other nuisances	Mediation by ecosystems

Add to table

ESS name	CICES section	CICES class	Beneficiary type	Beneficiary sub-type	
User-defined name 1	Regulation and maintenanc	Bio-remediation by micro-organisms, algae, plants, and animals	None	None	Remove
User-defined name 2	Regulation and maintenanc	Filtration/ sequestration/ storage/ accumulation by micro-organisms, algae, plants, and anim	None	None	Remove
User-defined name 3	Regulation and maintenanc	Maintaining nursery populations and habitats	None	None	Remove
User-defined name 4	Regulation and maintenanc	Mediation of smell/noise/visual impacts	None	None	Remove
User-defined name 5	Cultural	Experiential use of plants, animals and land-/seascapes in different environmental settings	Recreational	Experiencers	Remove

Tool will check that all ESS have been associated with a beneficiary (or "None") before the user can progress to the next step.

Figure 17 User story 3.8: Identify beneficiary types

Study description | Problem characterization | Responses and Beneficiaries | Impact evaluation | Sustainability assessment

Create measure | Describe capabilities | Select drivers | Select pressures | Select state parameters | Case-relevant ESS | Identify beneficiaries | Categorize stakeholders | Select ESS

Select Stakeholder: Stakeholder 3

Tool will check that all stakeholders have been associated with a beneficiary (or "None") before users can move on to the next step.

Categorize the selected stakeholder according to the following beneficiary types

	Main beneficiary type	Beneficiary sub-type (example)	Example of general beneficiary description (water focus)	Final ESS of relevance to the beneficiary
☐	None			
☑	Recreational	Experiencers and viewers	This beneficiary recreationally picks or gathers from the natural abundance of edible flora, fungi, and some fauna (as long as it is not fished or hunted). This beneficiary has potential contact with water.	opportunity to view the environment and organisms within it landscape that provides a sensory experience organisms (i.e., flowers, plants, etc.) that can be viewed organisms (i.e., birds, mam-mals, reptiles, etc.) that can be viewed sounds and scents that provide a sensory experience
☐	Recreational	Food pickers and gatherers	Toxics and other nuisances	Mediation by biota
☐	Recreational	Hunters	Toxics and other nuisances	Mediation by ecosystems

Add to table

Stakeholder	Main beneficiary type	Beneficiary sub-type (example)	
Stakeholder 1	None	None	Remove
Stakeholder 2	None	None	Remove
Stakeholder 3	Non-use	People who care (existence)	Remove
Stakeholder 3	Recreational	Experiencers and viewers	Remove

Figure 18 User story 3.9: Identify Beneficiaries and classify ESS as Final or Intermediate

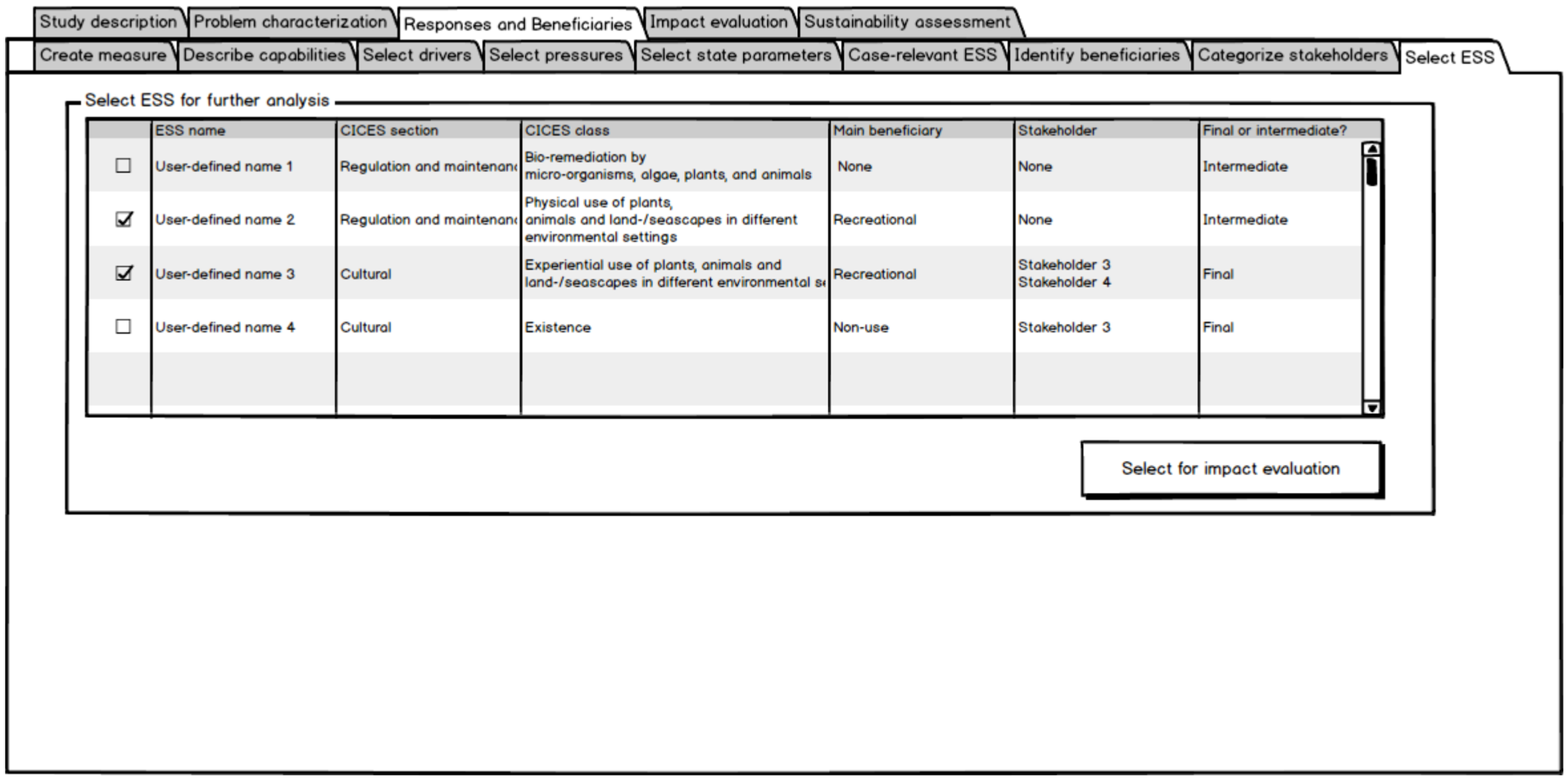

Figure 19 User story 3.10: Select ESS for further analysis

5 Epic 4: Description of Responses and identification of potential Beneficiaries

The purpose of Epic 4 is to assess the effect of the proposed measure (Response) on the system under examination by quantifying the state of the ecosystem, Impact I (ESS provision) and Impact II (ESS use). State, Impact I and Impact II have to be estimated for two scenarios: a baseline scenario (before) and one where the proposed measure is already implemented (after). Finally the scenarios are compared and the change in the elements of the DPSIR is evaluated.

5.1 Epic 4: User stories

User stories for Epic 4 are presented in Table 5.

Table 5 Epic 4: User stories

Id	Title	Story	Acceptance criteria	Importance (Must/should/could)	Estimate (Small/Medium/Large)
4.1	Identify case-relevant parameters of State	As an Evaluation lead or SME, I want to get a list of the parameters of State that were found to be affected by the proposed measure in 3.5 and 3.6 so that I can find indicators to measure them.	The software must retrieve the parameters of State previously found to be affected by the proposed measure. These must be presented in relation to the case-relevant ESS for clarity.	Must	Small
4.2	Assign State indicators	As a domain expert I want to get examples of indicators that can be used to measure my case-relevant parameters of State to facilitate the later analysis of State.	The user is presented with a list of examples including those in column D of worksheet “State indicators” and columns C and D of worksheet “Impact I Provision indicators” in the supplementary material file. The user is prompted to assign State indicators to each of the case-relevant parameters of State based on the examples presented or the creation of custom indicators. The user is prompted to create custom indicators using text entry.	Must	Medium
4.3	Select/load existing State indicators and script new ones	As a techie I want to select or load existing State indicators and script new ones so that I can compute them to analyse changes in State parameters.	The user is presented with information on the existing State indicator scripts from the indicator script library in MIKE WORKBENCH. The user can select existing State indicators from the library and use them in his model. The user has access to the scripting capabilities of MIKE WORKBENCH. The user can load existing scripts or script new state indicators to be used in the analysis.	No scripting library will be developed; other functionality already available	N/A

4.4	Select Impact I indicators/proxies	As a domain expert I want to get examples of indicators or proxies that can be used to relate parameters of State to ESS provision to facilitate the later analysis of Impact I.	The user is presented with a list of examples including those in columns C and D of worksheet “Impact I Provision indicators” in the supplementary material file.	Must	Medium
4.5	Select/load existing Impact I indicators/proxies and script new ones	As a techie I want to select or load existing Impact I indicator scripts and script new ones so that I can compute them to analyse changes in ESS provision.	• The user is presented with information on the existing Impact I indicator scripts from the indicator scripts library in MIKE WORKBENCH. • The user can select existing Impact I indicator scripts from the library and use them in the analysis. • The user has access to the scripting capabilities of MIKE WORKBENCH. The user can load existing scripts or script new Impact I indicators to be used in the analysis.	No scripting library will be developed; other functionality already available	N/A
4.6	Assign Impact II (ESS Use) Indicators	As a domain expert I want to get examples of indicators to measure the use of case-relevant Final ESS so I can complete the later quantification of Impact II.	The user is presented with the list of case-relevant Final ESS to be further analysed (stories 3.9 and 3.10), showed according to CICES section, class and class type. As guidance, for each listed ESS class type, the user is presented with examples from column G (*Examples of Impact II (ESS Use) Indicator(s)*) of the Impact II Use indicators worksheet in the Supplementary Material File. The user has the capability to select an ESS use indicator from the examples presented or insert a custom one	Must	Medium
4.7	Get examples of valuation methods and monetary values related to the case-relevant Final ESS	As an evaluation lead or SME or domain expert I want to consult examples of valuation methods and economic values from the available economic literature that are relevant to assess changes in Final ESS in order to give me an idea of the range of values that the implementation of the technology may deliver.	Following the previous story, The user is presented with two levels of information: In level I, the user is presented with a list of valuation method examples including those in column H *(Valuation Method(s)*); and references from column I (*Data/Literature*) of the Impact II Use indicators worksheet in the Supplementary Material File. In level II, the user is presented with extended information for any given study of his/her choice from column I (*Data/Literature*) of the Impact II Use indicators worksheet in the Supplementary Material File. The extended information about each specific study can be found in the Impact II Monetization worksheet in the Supplementary Material File. This is the studies table (all columns) and abstracts table per study.	Should	Medium
4.8	Assign monetary values	As a Domain expert (economist) I would like to introduce values for specific	A table similar to Table 11 in the DESSIN Cookbook (D11.2) is generated with the first two columns populated with the Final ESS and Beneficiaries identified in previous steps. The user is prompted to complete the table with	Must	Small

		Final ESS to complete the Impact II analysis.	assistance from the information obtained in 4.7, as well as the cookbook and companion document (also part of D11.2).		
4.9	Load data and modes from MIKE Workbench	As techie, I want to be able to load data into the system for the baseline and after implementation scenarios for all the indicators to measure changes in State, Impact I and Impact II that were previously selected by the domain experts so the Evaluation lead can proceed to quantify changes in ESS.	The user has the capability to load the models, datasets, etc. that will be necessary for quantification later on. The user should have the capability to access and adapt existing datasets and tools from the MIKE WORKBENCH libraries.	Functionality already available	N/A
4.10a	Compare before-after simulations: Tables	As an Evaluation Lead or SME, I want to be able to quantify all the indicators to measure changes in State, Impact I and Impact II that were previously selected and prepared by the domain experts so I can complete the evaluation of changes in ESS and proceed to reporting.	The user must be able to run simulations and compute the previously selected indicators using the loaded data. The user must be able to define the time range for which the indicators are quantified. The user interface should be targeted at the Evaluation Lead or SME (i.e. non-expert users). The user must be able to compare between the results of the baseline and after implementation scenarios with ease. I can export results to Excel so that I can make custom plots and other reporting tools.	Must	Medium
4.10b	Compare before-after simulations: Charts and other output features	As an Evaluation Lead or SME, I want to be able to quantify all the indicators to measure changes in State, Impact I and Impact II that were previously selected and prepared by the domain experts so I can complete the evaluation of changes in ESS and proceed to reporting.	All outputs must be presented in a way that facilitates the reporting of results (e.g. integrating study area description, characterisations of Drivers and Pressures, lists of Beneficiaries, Final and Intermediate ESS and changes in both with flowing text conclusions added by the user at the last stage of the evaluation). Specific requirements include: • Bar charts comparing indicator values before and after • Pie charts showing distribution of indicator values along a river reach	Could	Large

5.2 Epic 4: Storyboard

This section presents mock-ups of the visual appearance of the stories outlined in Epic 4.

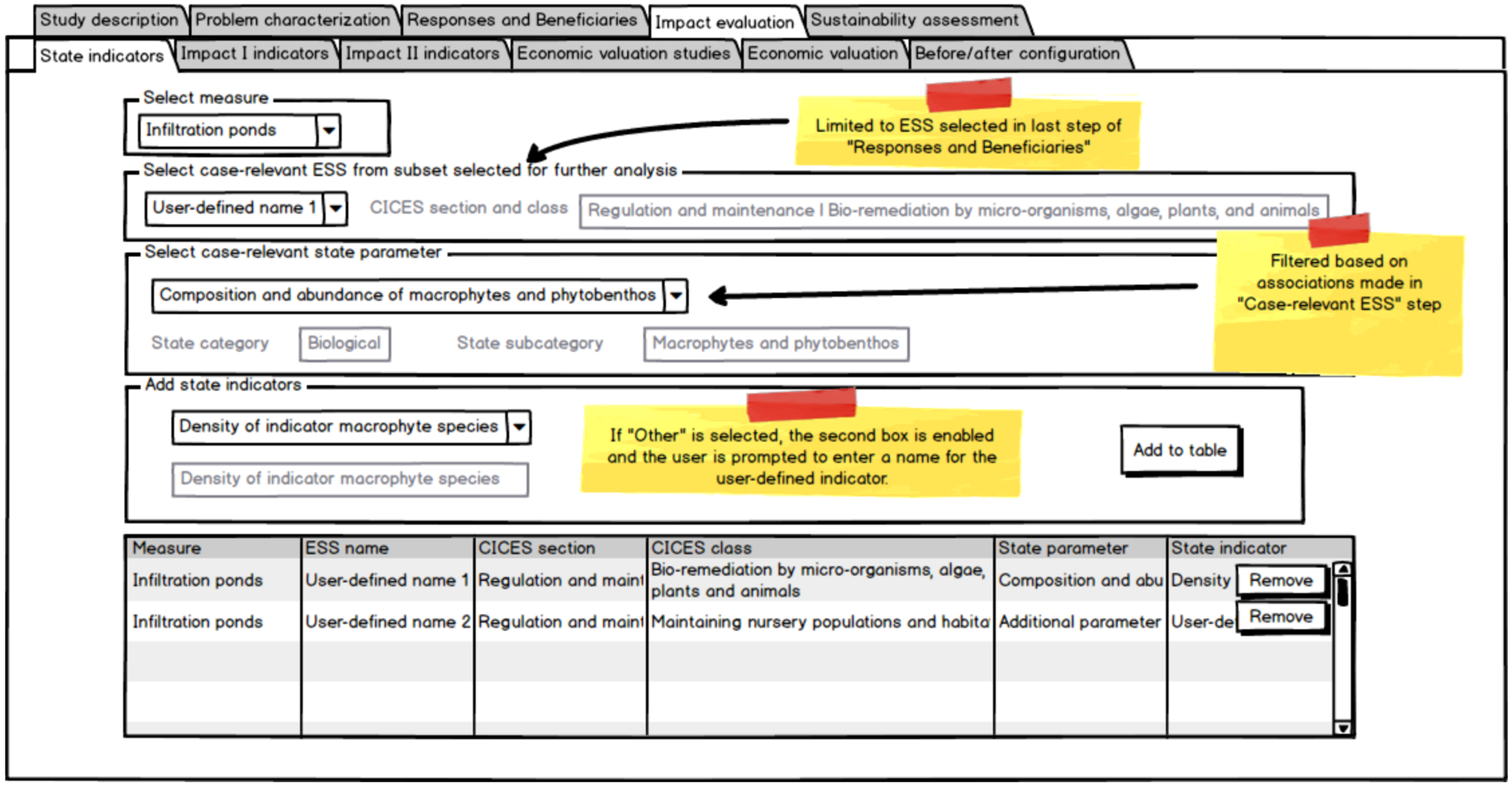

Figure 20 User stories 4.1-4.2: Identify case-relevant parameters of State, assign State indicators

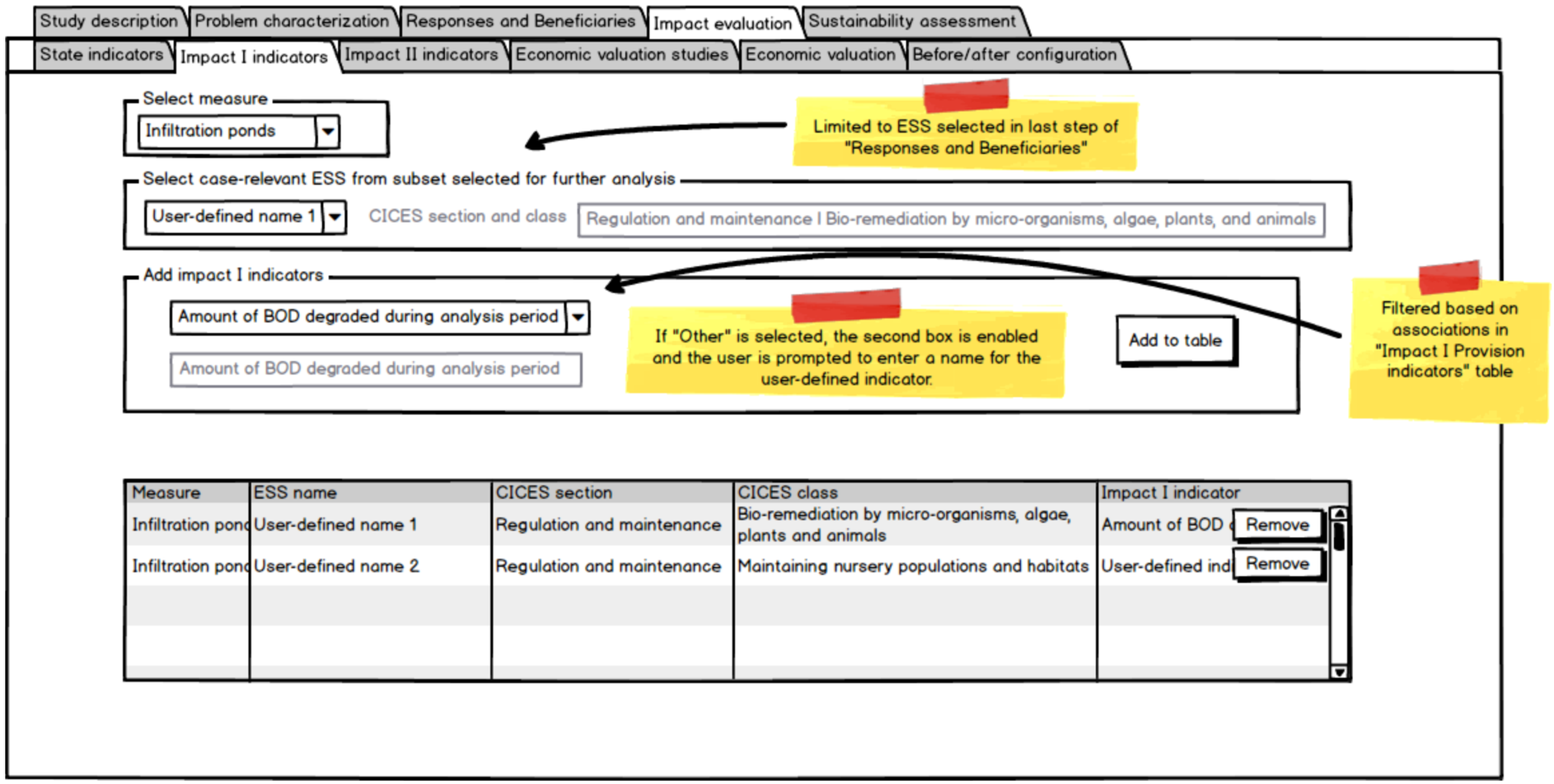

Figure 21 User story 4.4: Select Impact I indicators/proxies

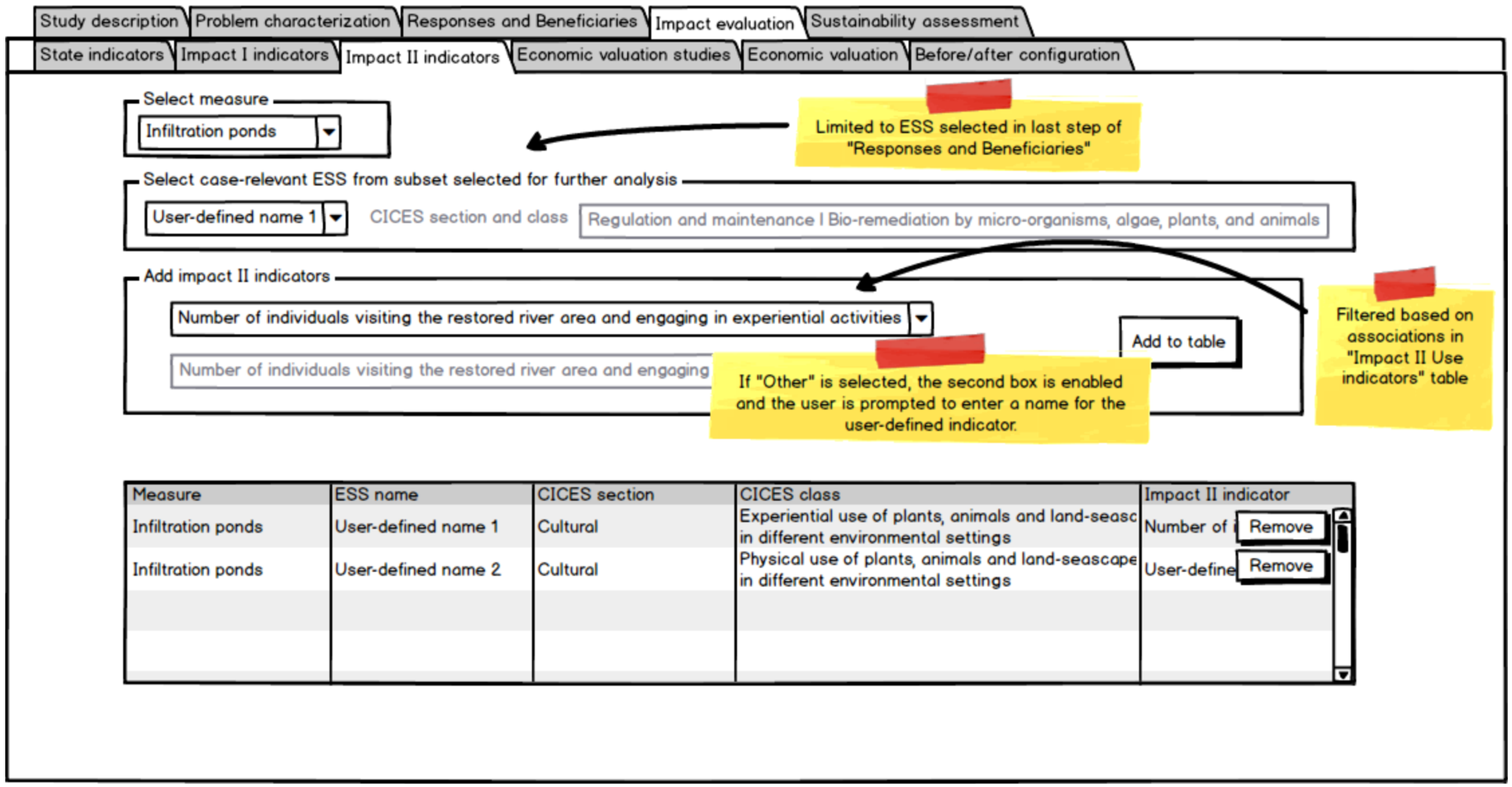

Figure 22 User story 4.6: Assign Impact II (ESS Use) Indicators

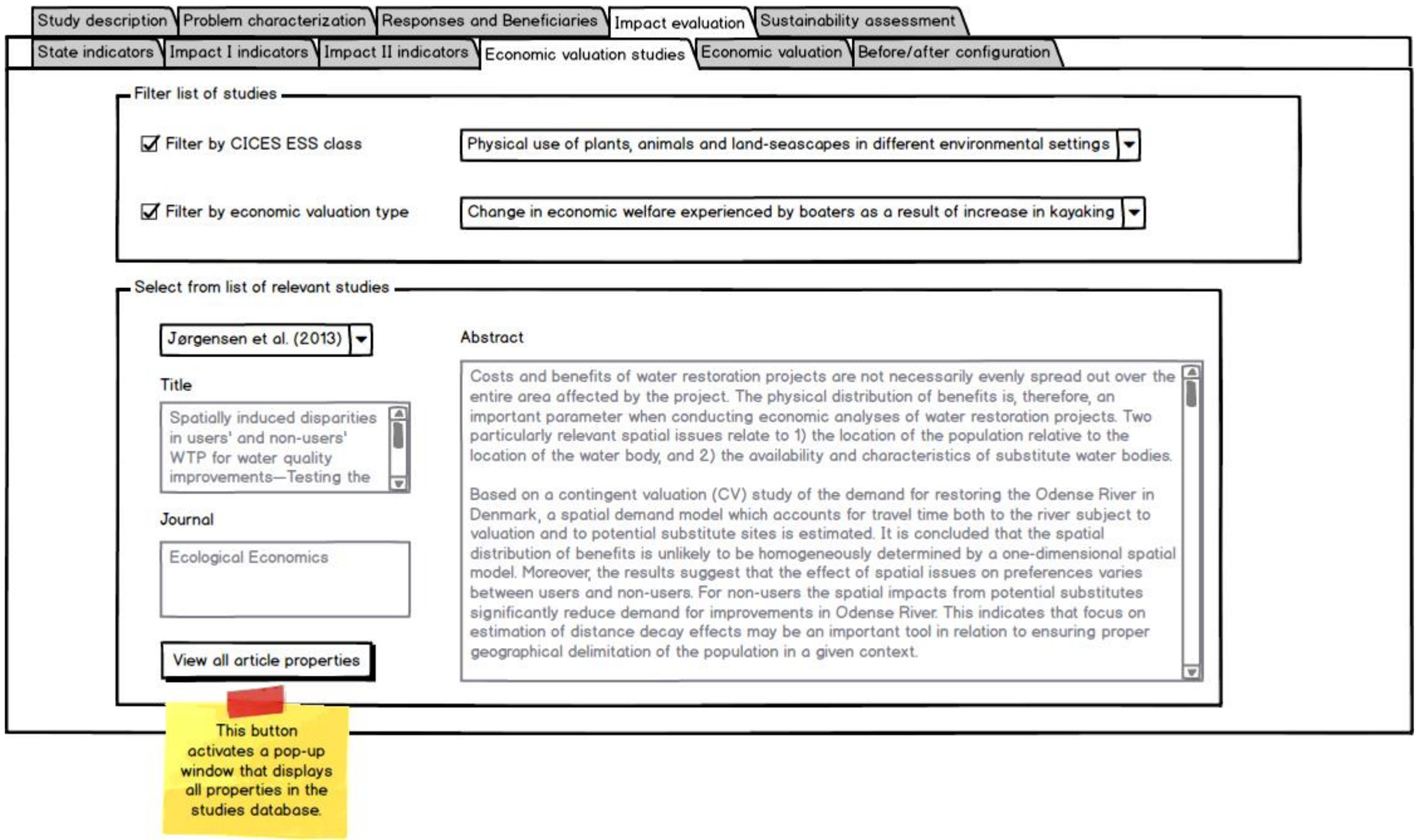

Figure 23 User story 4.7: Get examples of valuation methods and monetary values related to the case-relevant Final ESS

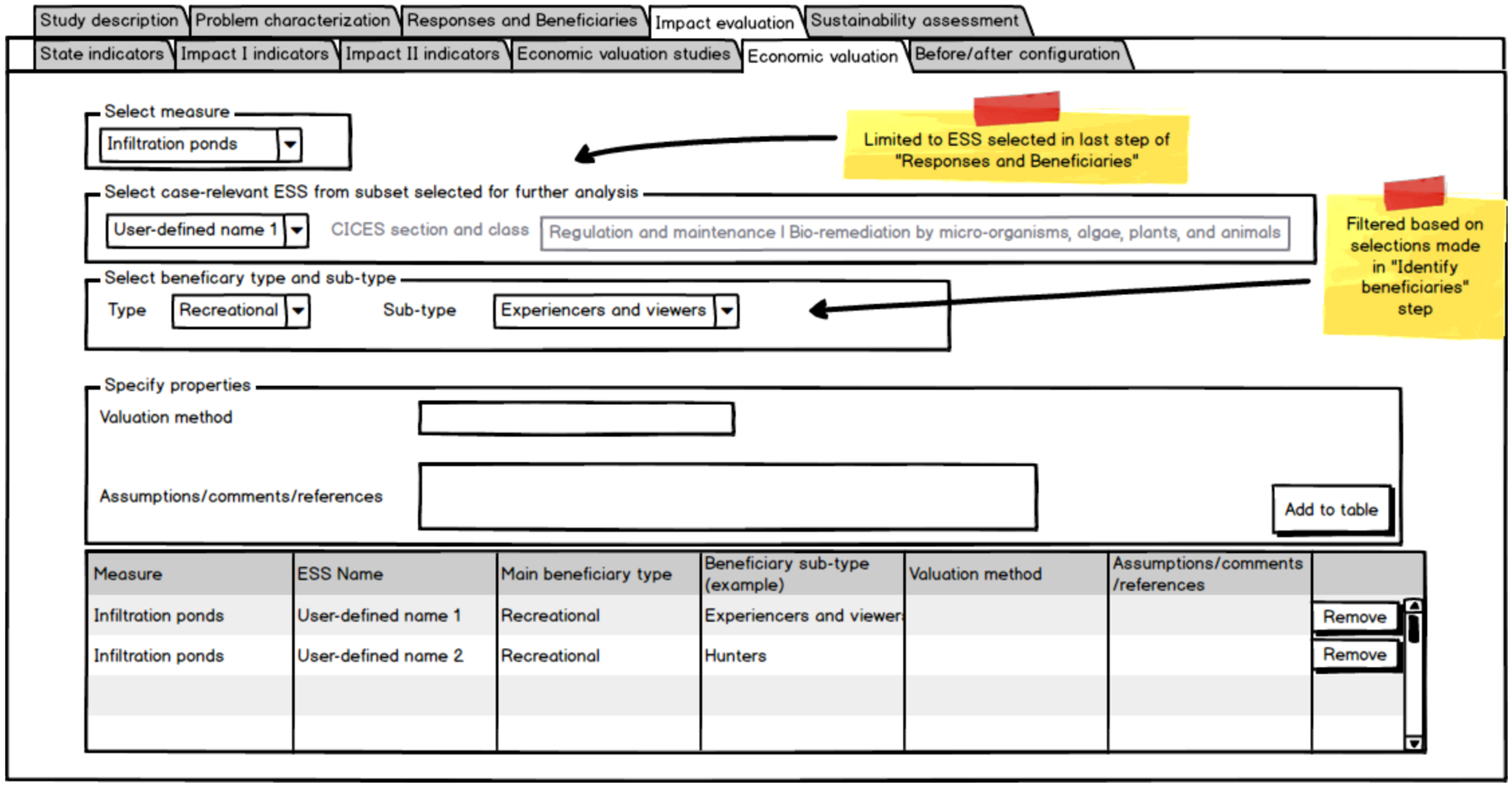

Figure 24 User story 4.8: Assign monetary values

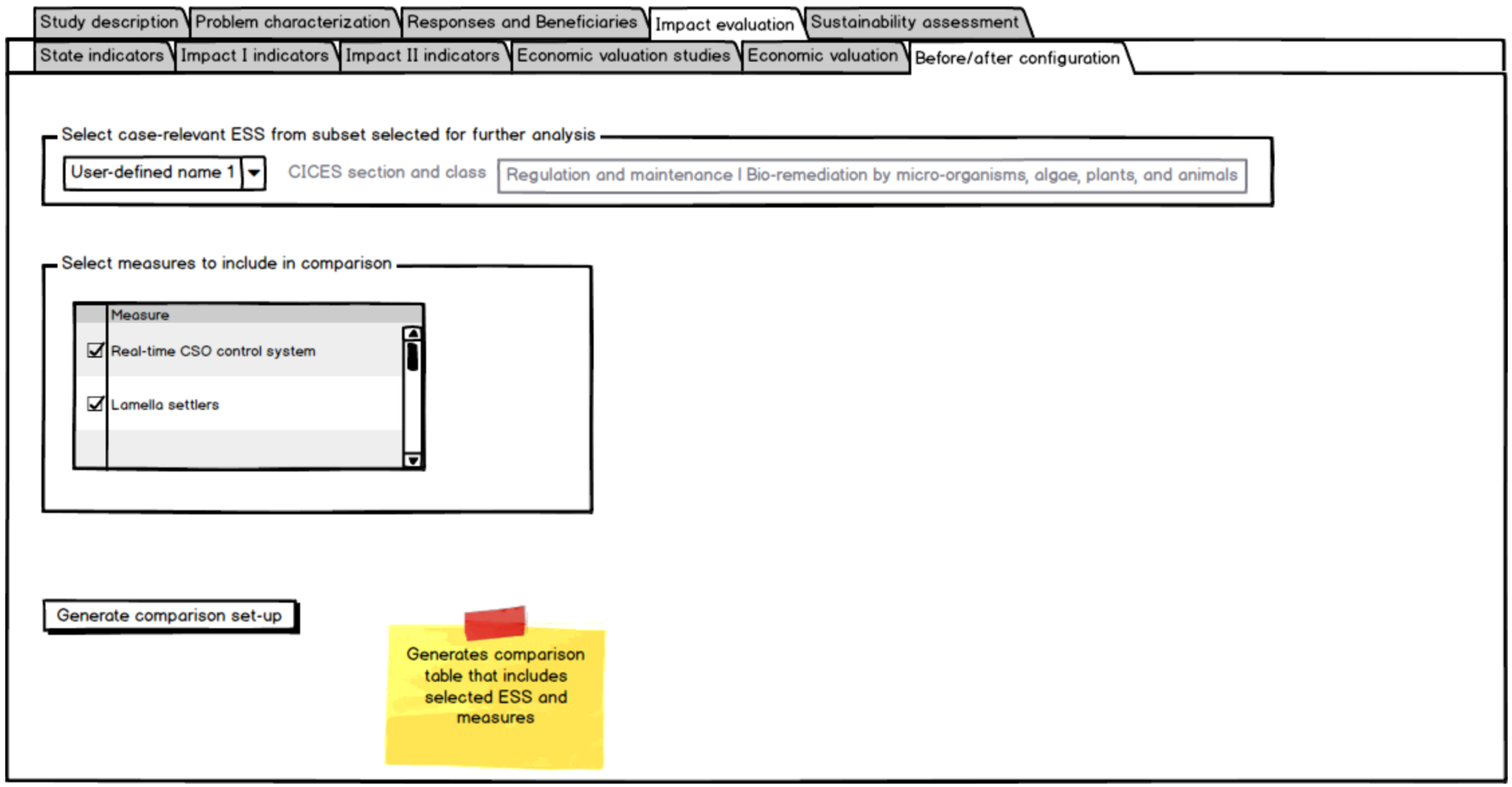

Figure 25 User story 4.10a: Compare before-after simulations: Tables

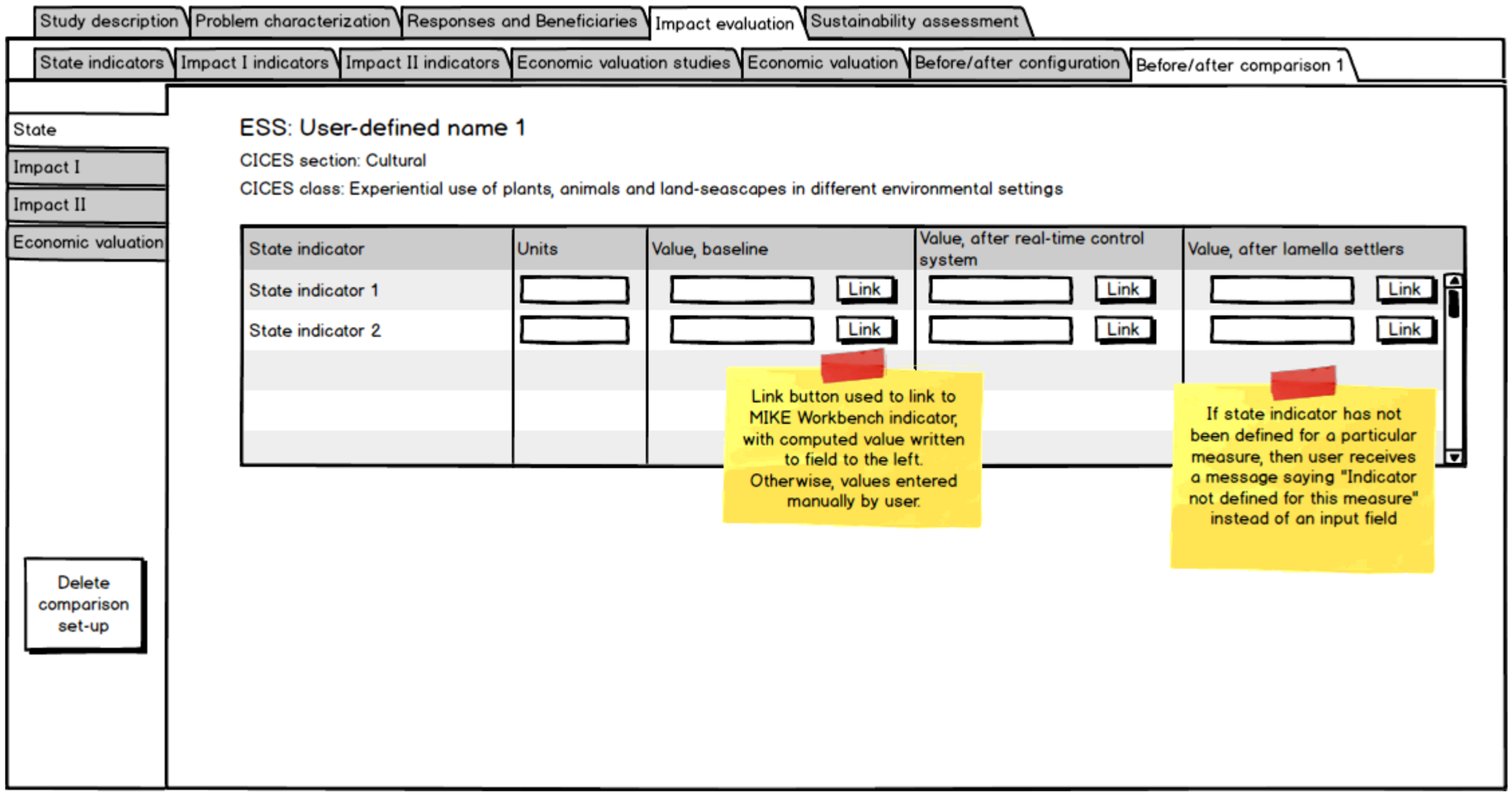

Figure 26 User story 4.10a: Compare before-after simulations: Tables

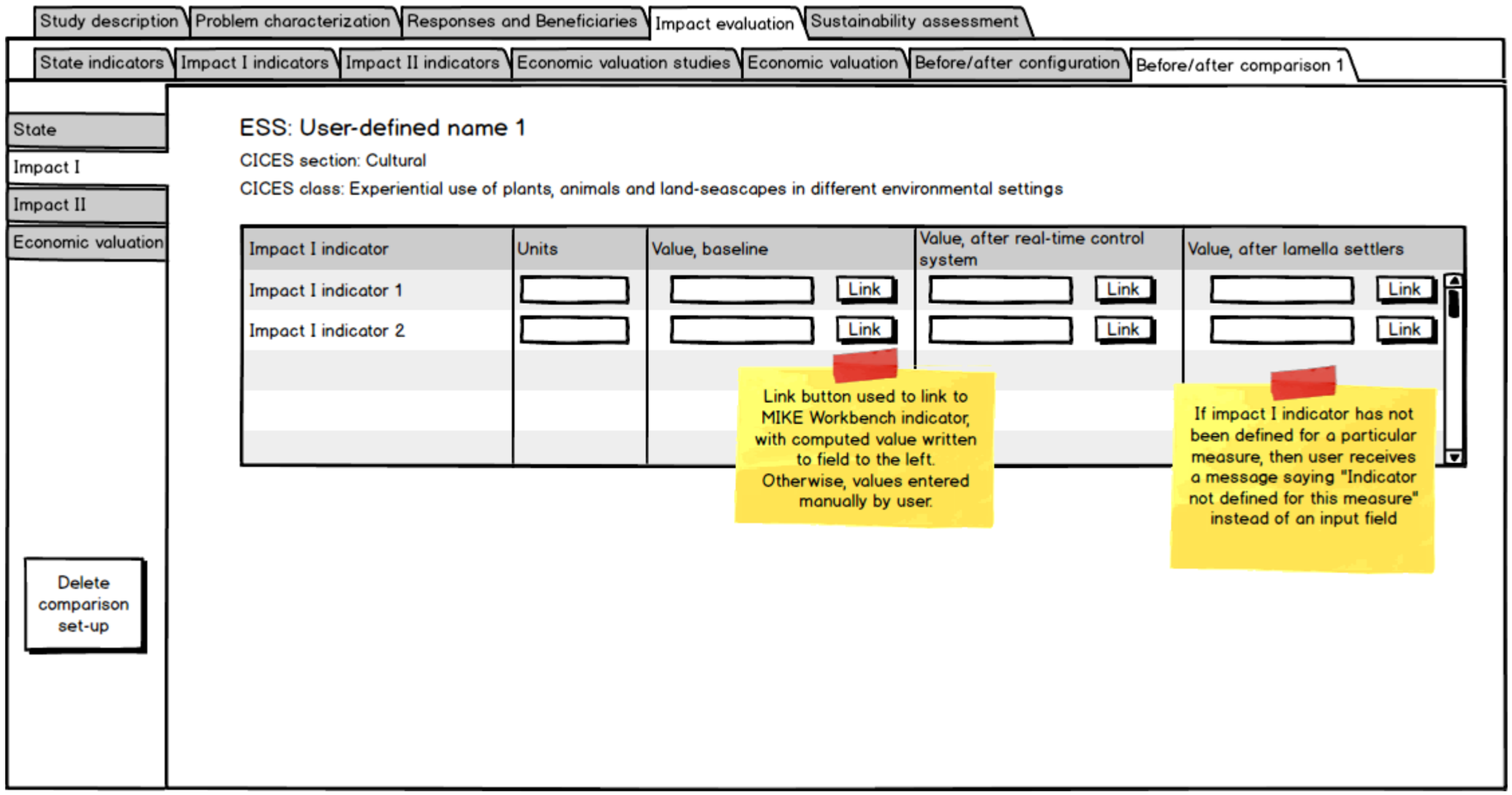

Figure 27 User story 4.10a: Compare before-after simulations: Tables

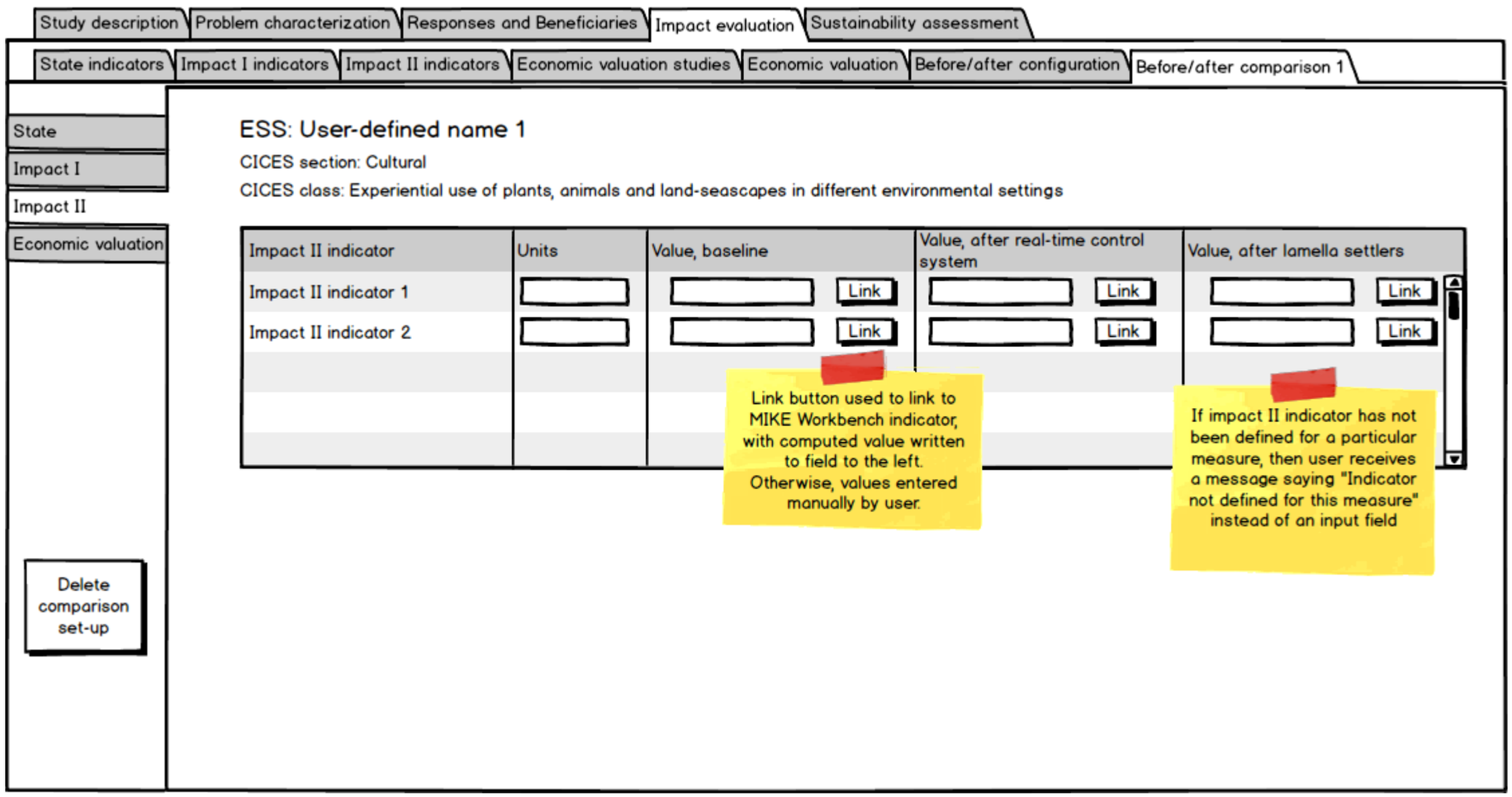

Figure 28 User story 4.10a: Compare before-after simulations: Tables

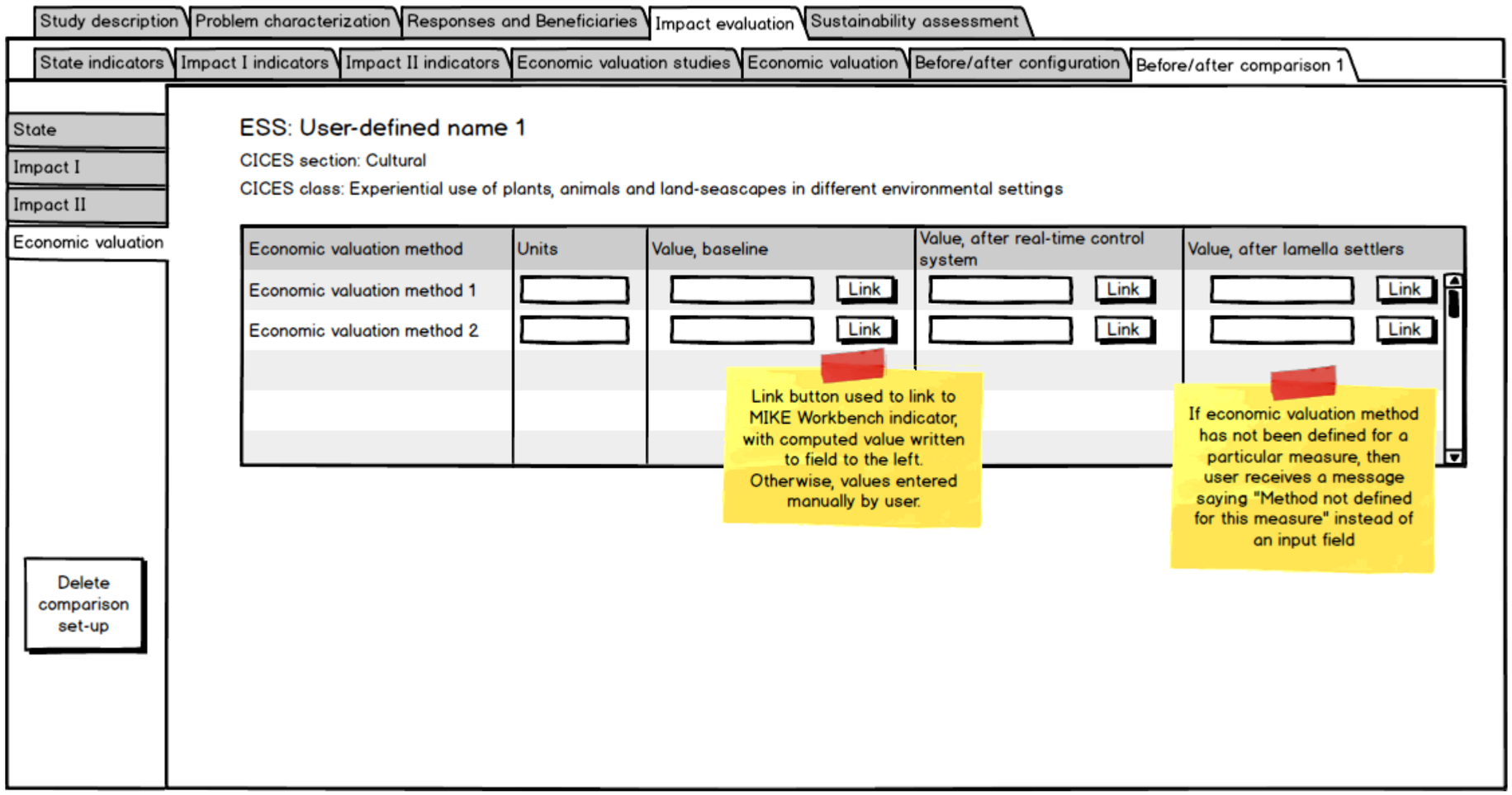

Figure 29 User story 4.10a: Compare before-after simulations: Tables

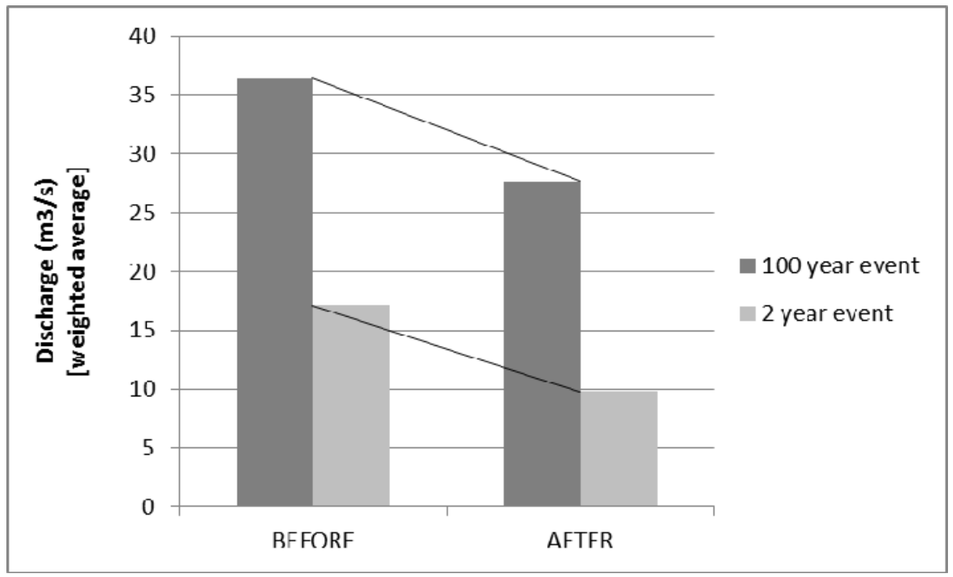

Figure 30 User story 4.10b: Compare before-after simulations: Charts and other output features (Bar charts comparing before/after values)

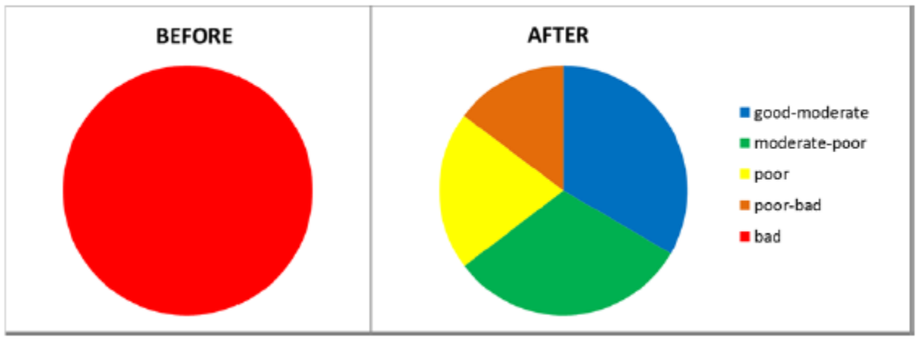

Figure 31 User story 4.10b: Compare before-after simulations: Charts and other output features (Pie chart comparison of distribution of values along a river reach)

6 Epic 5: Sustainability assessment

The purpose of this chapter is to supplement the ESS evaluation by advising how to conduct an additional sustainability assessment (SA) of innovative solutions aimed at mitigating water scarcity or water quality issues. The SA allows the user of the DESSIN ESS Evaluation Framework to widen the analysis, putting the evaluated changes in ESS into perspective by considering multiple dimensions. These multiple dimensions include wider social, environmental, financial, governmental, and asset performance aspects of the examined solution. This allows for the consideration of potential disadvantages like costs and environmental effects (e.g. additional greenhouse gas emissions) and their comparison with the advantages in terms of benefits expected from implementing the solution.

6.1 Epic 5: User stories

User stories for Epic 5 are presented in Table 6.

Table 6 Epic 5: User stories

Id	Title	Story	Acceptance criteria	Importance (Must/should/could)	Estimate (Small/Medium/Large)
5.1	Defining system boundary	As an Evaluation lead or SME, I would like to make use of the system boundaries defined within part I so that consistency in assessment is guaranteed (in space and time).	I am able to make use of the data inserted in part I (e. g. system boundary and information about economic activities). The SA uses the same Eurostat region definition that was selected in Epic 1.	Will not be implemented	N/A
5.2	Specify number of technologies to compare, along with water system type	As an Evaluation lead or SME, I want to define the water system type and number of technologies so that I can filter the indicator list in the next step.	I am able to specify the number of technologies that will be compared. I am prompted to provide a text description. I am able to specify whether the system is a water supply or wastewater system.	Must	Small
5.3	Define time scales	As an Evaluation lead or SME, I would like to make use of the system boundaries defined within part I so that consistency in assessment is guaranteed (in time).	I am able to specify a lifetime for each technology under consideration. I am able to specify a start-up time for each technology under consideration. I am able to define a common start time for the analysis. I am able to define one or more times in the future when I would like to take a snapshot of the performance of each technologies under consideration. All times are time periods are defined in units of years.	Must	Medium

5.4	Select relevant indicators	As an Evaluation lead or SME, I want to select sustainability indicators from a list so that I know which indicators are relevant for my assessment.	The indicator list should contain all indicators from the sustainability indicator list grouped by dimension, objectives and criteria. I am presented with an indicator list that is filtered based on whether I am analysing one technology or comparing more than one. I am presented with an indicator list that is filtered based on the water system type. I am able to select indicators from this list. Each indicator is populated with a set of properties. Columns A-L in the supplementary file (SA).	Must	Small
5.5a	Define data availability	As an Evaluation lead or SME, I want to indicate whether there is quantitative data available for each of the selected indicators or not so that I know whether the indicator will be assessed quantitatively or qualitatively further on.	I am able to indicate data availability for each indicator by choosing between “yes” or “no”. All indicators rated “yes” will be assessed quantitatively. All indicators rated “no” will be assessed qualitatively. An overview of my current sustainability indicator list and all specifications made up to this point is available. All indicators will be designated consistently across technologies	Must	Small
5.5b	Add threshold and target values	As an Evaluation lead or SME, I want to add regulatory thresholds and target values so that these can be used to normalize indicators in later MCDA steps.	I can add a regulatory threshold value where one exists. I can add a target value where one exists.	Must	Small
5.6	Creation of new indicators	As an Evaluation lead or SME, I want to create additional indicators to supplement those selected from the standard list.	I can populate all necessary properties for each indicator. I am able to assign new indicators to a certain dimension, objective and criteria.	Must	Small
5.7a	Enter indicator values	As an Evaluation lead or SME, I want to insert values for each of the selected sustainability indicators so that I can calculate with these values further on.	Two or more fields should be presented for each indicator: one for inserting a “before” value and one or more for the “after” values. The number of "after" values should be the same as the number of snapshots of the future defined in 5.3. The “after” values are labelled using the snapshot times defined in 5.3. I can enter direct values. I can add a reference to each value inserted in a text field.	Must	Small
5.7b	Associate indicator values with indicator scripts	As an Evaluation lead or SME, I want to associate indicator	I can compute indicator values from indicator scripts. The indicator scripts can accept time series input.	Should	Medium

		values with scripts developed in MIKE Workbench so that I can calculate with these values later on.	I am able to extract data from a model that I connected to MIKE Workbench.		
5.8	Link back to State, Impact I and Impact II indicators	As an Evaluation lead or SME, I want to use State, Impact I or Impact II results to value my selected sustainability indicators so that I don´t have to recalculate them.	I am able to select and take over single result values from parts III and IV. I am able to calculate indicators based on data and time series inserted in parts III and IV. Data that is taken from the ESS Evaluation part should be marked in the table with an automatic reference provided.	Must	Medium
5.9	Life Cycle Assessment	As a domain expert or SME, I want to perform a quick life cycle assessment of my technology so that I can serve the indicators of En2 without running a separate assessment.	I am able to perform a rough life cycle assessment (just carbon footprint): I can calculate GHG emission in three different ways: (1) those emitted directly from fossil fuel consumption during the solution use such as water pumping to the atmosphere; (2) those emitted indirectly from electricity consumption in the solution such as water pumping, water treatment to the atmosphere; (3) those emitted indirectly from material flux (resulted from embodied energy of materials) and chemicals used for treatment processes. I am asked to insert the total fossil fuel consumption, the electricity consumption and the material and chemical fluxes for each solution. I can select from a database the conversion coefficient as kg of CO_2 equivalent per consumption unit and is specific for different energy types, chemicals and materials. **OR** I am asked to specify the conversion coefficient, to be applied, as kg of CO_2 equivalent per consumption unit and is specific for different energy types, chemicals and materials. All the aforementioned GHG emissions are calculated by multiplying the amount of energy, chemical and material consumed by a conversion coefficient for that specific energy, chemical and material. GHG emission is reported in kg of CO_2 emissions equivalent Results of the life cycle assessment are directly allocated to the respective indicator of En213.	Will not be included	N/A
5.10	Checking cost coverage	As an Evaluation lead or SME, I want to check the cost coverage of the solution so that I can present this as a result to a decision maker or customer.	I can select indicators from those calculated in the financial dimension. I can define specific interest rates, a discounting rate and the time horizon of the analysis. I can introduce the values for "r", the discount rate, such as the rate of inflation, and for "t", the number of compounding periods, such as years into the future. I can calculate the discounted value of costs using the following net present value formula: NPV = value / (1 + r)^t	Will not be included	N/A

			I am able to add all present value of costs. I can assess the cost coverage. If the number is higher than 0, then cost coverage is guaranteed.		
5.11	Describing indicators qualitatively	As an Evaluation lead or SME, I want to add a qualitative description to each indicator I do not have quantitative data available for so that these indicators will not be neglected in the assessment.	I can describe each indicator qualitatively in a text field. It is possible to add a score value to each indicator referring to a scale from 1 to 5 (strong negative impact – some negative impact – neutral – some positive impact – strong positive impact).	Must	Medium
5.12a	Visualisation of results	As an Evaluation lead or SME, I want to show the results graphically so that I can better present them to my stakeholders and customers.	I can compare the performance per indicator of each solution for the baseline scenario and the after implementation scenario (to the regulatory threshold) in a bar chart. The after implementation scenario can be represented by one or more of the periods for snapshot analysis selected in 5.3. It is possible to view results at two or more points in the future. I can compare the performance level of each solution for several indicators for the baseline scenario and the after implementation scenarios by comparing the indicator values from different points in each time series. I can select a point in the future to compare.The indicators should be normalized to a regulatory threshold. I can choose which indicators should be presented in the graph(s). I can export results to Excel so that I can make custom plots and other reporting tools.	Should	Medium
5.12b	Visualisation of results	As an Evaluation lead or SME, I want to show the results graphically so that I can better present them to my stakeholders and customers.	Other plotting and reporting functionality, including: • Spider plots	Could	Large
5.13	MCDA currently implemented	As an Evaluation lead or SME, I want to perform a multi-criteria decision analysis (MCDA) so that I can make my final decision on implementing the solution or not.	I can select dimensions for each scenario (before and after), and then select relevant indicators for each dimension. All indicator values are normalized automatically after the user defines if the highest or the lowest value is the best for each. I can add a weighting on the indicator level, the criteria level or the dimension level. All weightings add up to 100 %.	Will not be implemented	N/A
5.14	MCDA using compromise Programming (CP)	As an Evaluation lead or SME, I want to perform a multi-criteria decision analysis	I can select dimensions for each scenario (before and after), and then select relevant indicators for each dimension.	Will not be implemented	N/A

		using CP so that I can make my final decision on implementing the solution or not.	I do not only aim at ranking those indicators derived directly from the SAT but also anything else that is incorporated into the host environment. I can define a target value (f_k^0) or each k-th indicator as reference, or "ideal" point (as for 5.7) For each k-th indicator i can introduce a weight w_k For each scenario the calculated values of each k-th indicator ($f_k(x)$) are available. I can choose the value for p (1, 2, or ∞so to drive the type of CP) (check for details on the resulting CP formula for p=1,2 or ∞ at http://www.hindawi.com/journals/mpe/2012/178651/) I am presented with a winning scenario based on CP formula: $$minimize \left\{\sum_{k=1}^{n} w_k\left[f_k(x) - f_k{}^0\right]^p\right\}^{\frac{1}{p}}, \quad w_k > 0, \qquad 1 \le p \le \infty$$ Results from the CP are depicted on a final table.		
5.15	CBA	As an Evaluation lead or SME, I want to perform a cost-benefit analysis so that I can make my final decision on implementing the solution or not.	I can select the indicators, from those calculated in monetary terms to estimate the cost part of the analysis. I can select the indicators, from those calculated to be used to estimate the benefits side of the analysis and convert them in monetary terms. I can define specific interest rates, a discounting rate and the time horizon of the analysis. I can introduce the values for "r", the discount rate, such as the rate of inflation, and for "t", the number of compounding periods, such as years into the future. I can calculate the discounted value of each cost and benefit using the following net present value formula: NPV = value / (1 + r)^t. I am able to add each present value of cost and benefit. I can divide the present value of benefits by the present value of costs. I can assess the cost-benefit ratio. If the number is less than 1.0, then the cost-benefit analysis is negative. If it's greater than 1.0, then there's a positive return.	Will not be implemented	N/A

6.2 Epic 5: Storyboard

This section presents mock-ups of the visual appearance of the stories outlined in Epic 5.

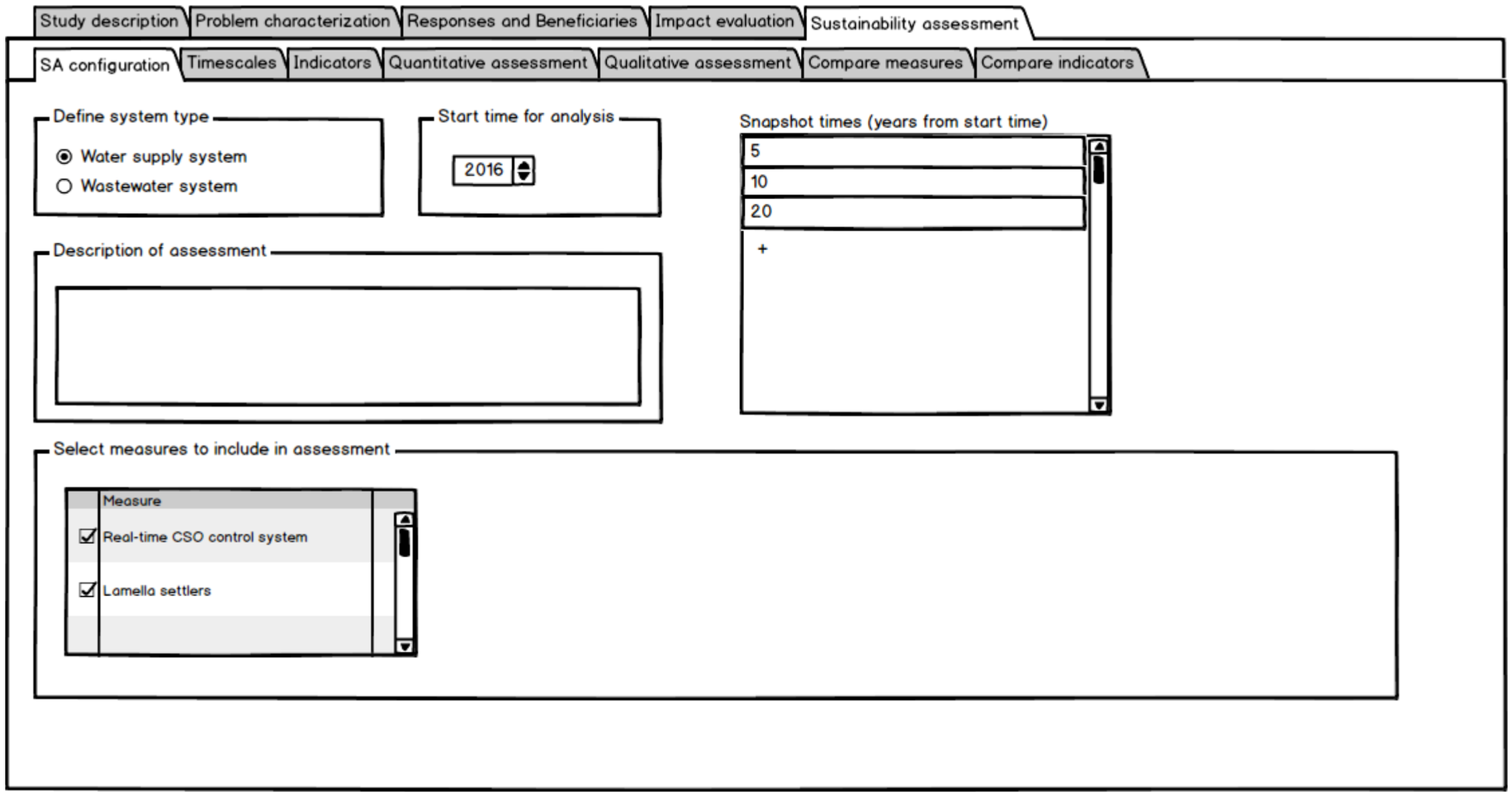

Figure 32 User story 5.2: Specify number of technologies to compare, along with water system type

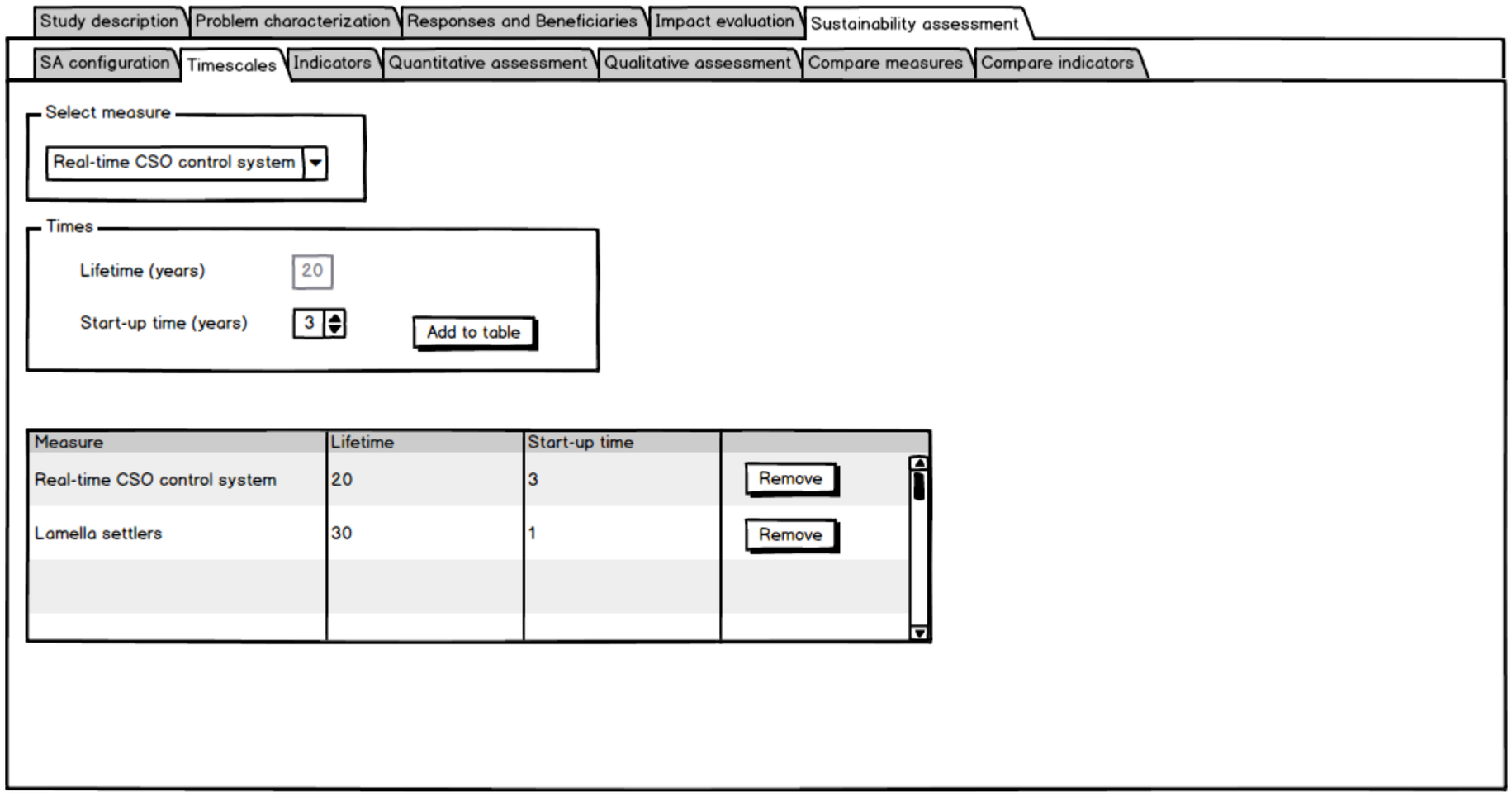

Figure 33 User story 5.3: Defining time scale

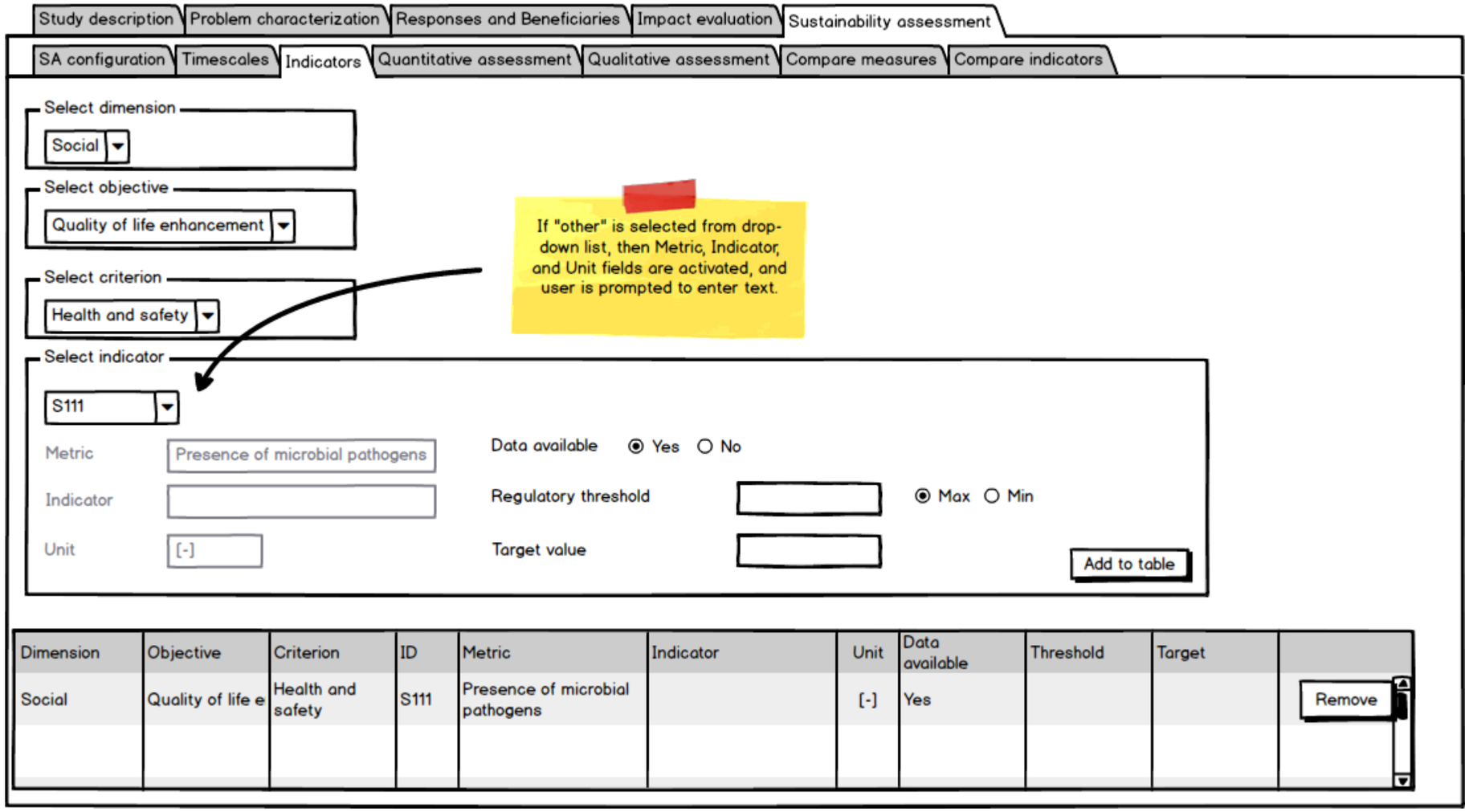

Figure 34 User stories 5.4, 5.5a, 5.6: Selection of relevant indicators, Defining data availability, Creation of new indicators

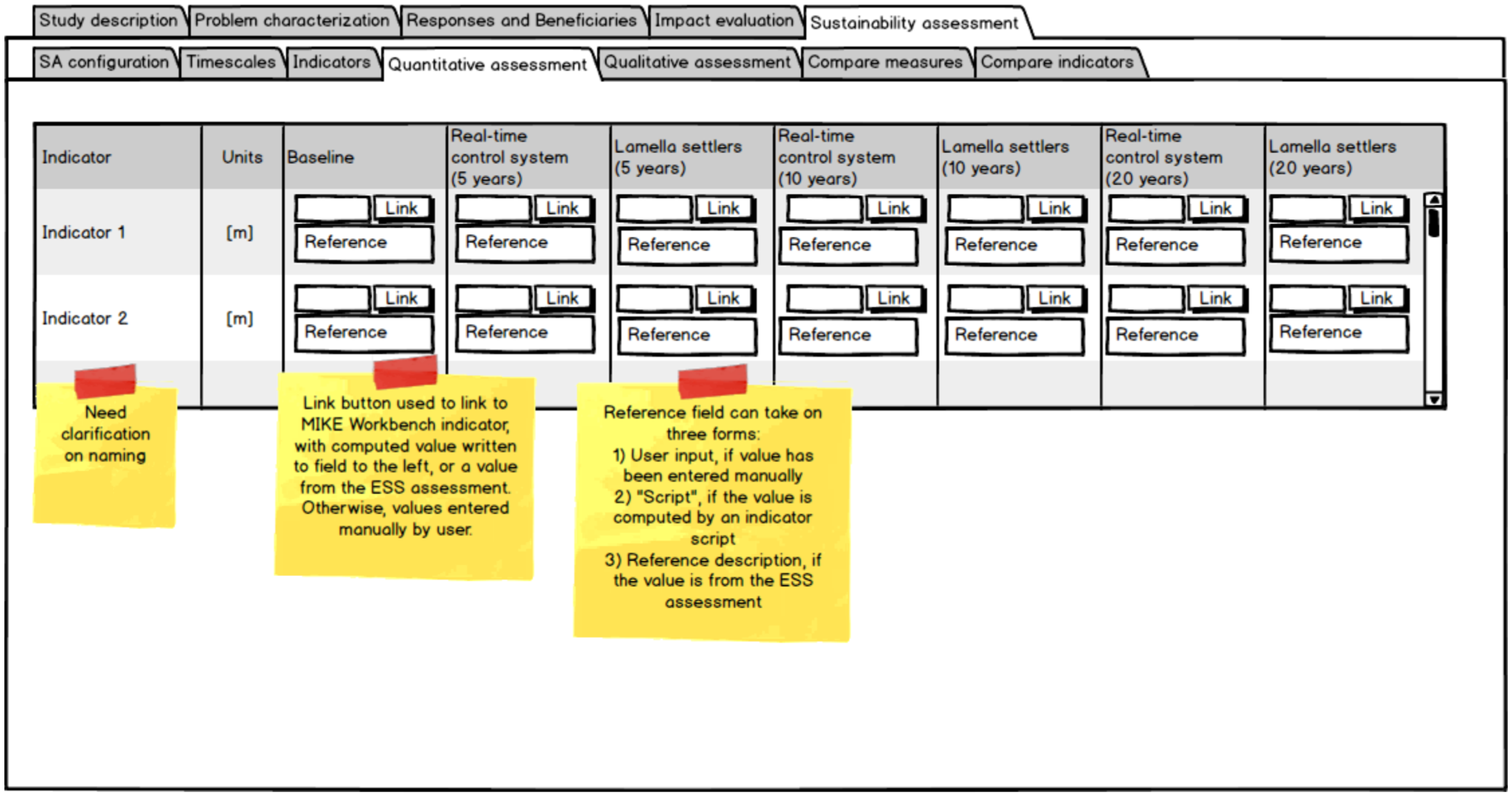

Figure 35 User stories 5.7a, 5.7b, 5.8: Enter indicator values, Associate with indicator scripts, Link back to State, Impact I and Impact II indicators

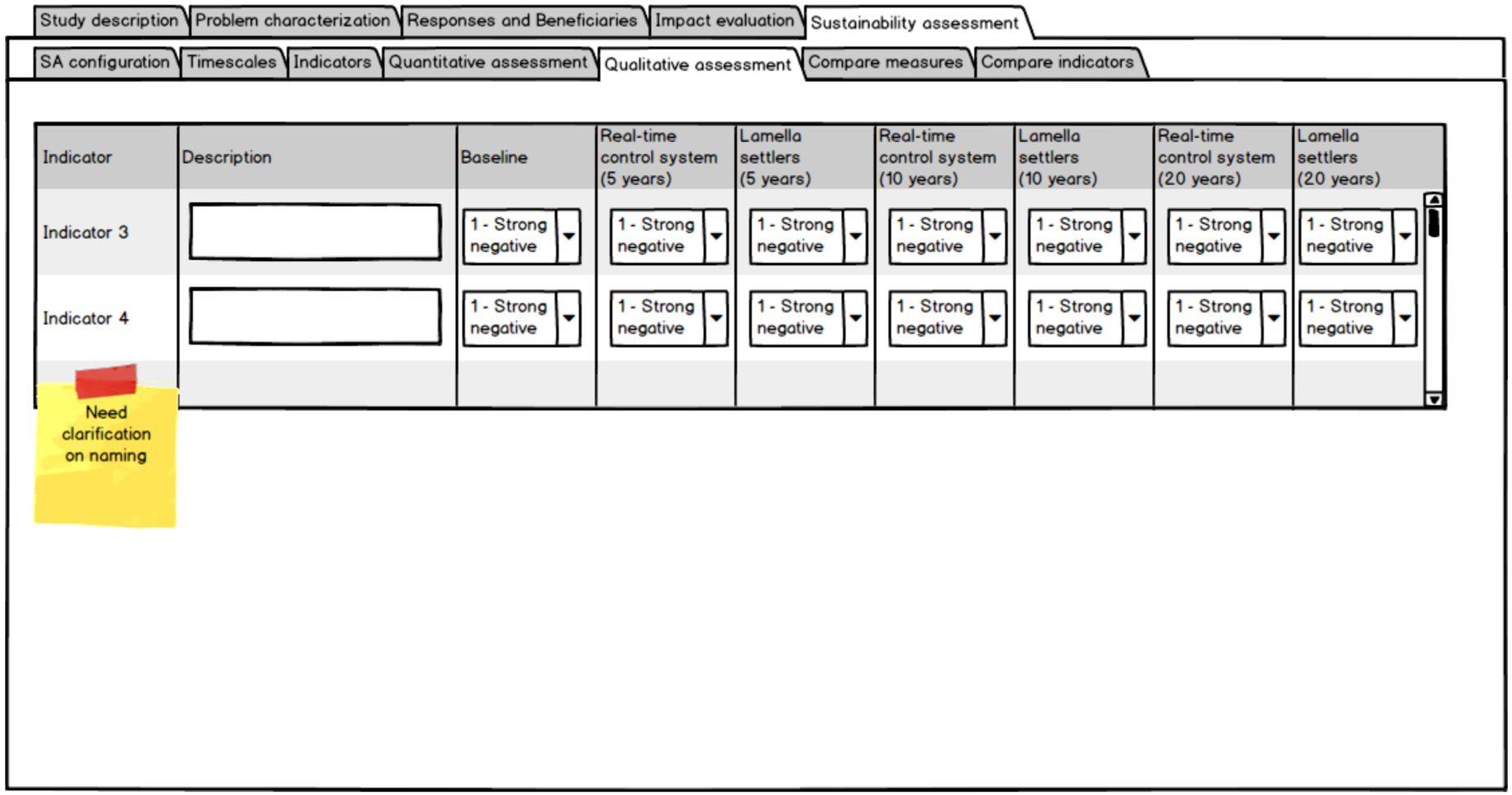

Figure 36 User story 5.11: Describing indicators qualitatively

Figure 37 User story 5.12a: Visualisation of results

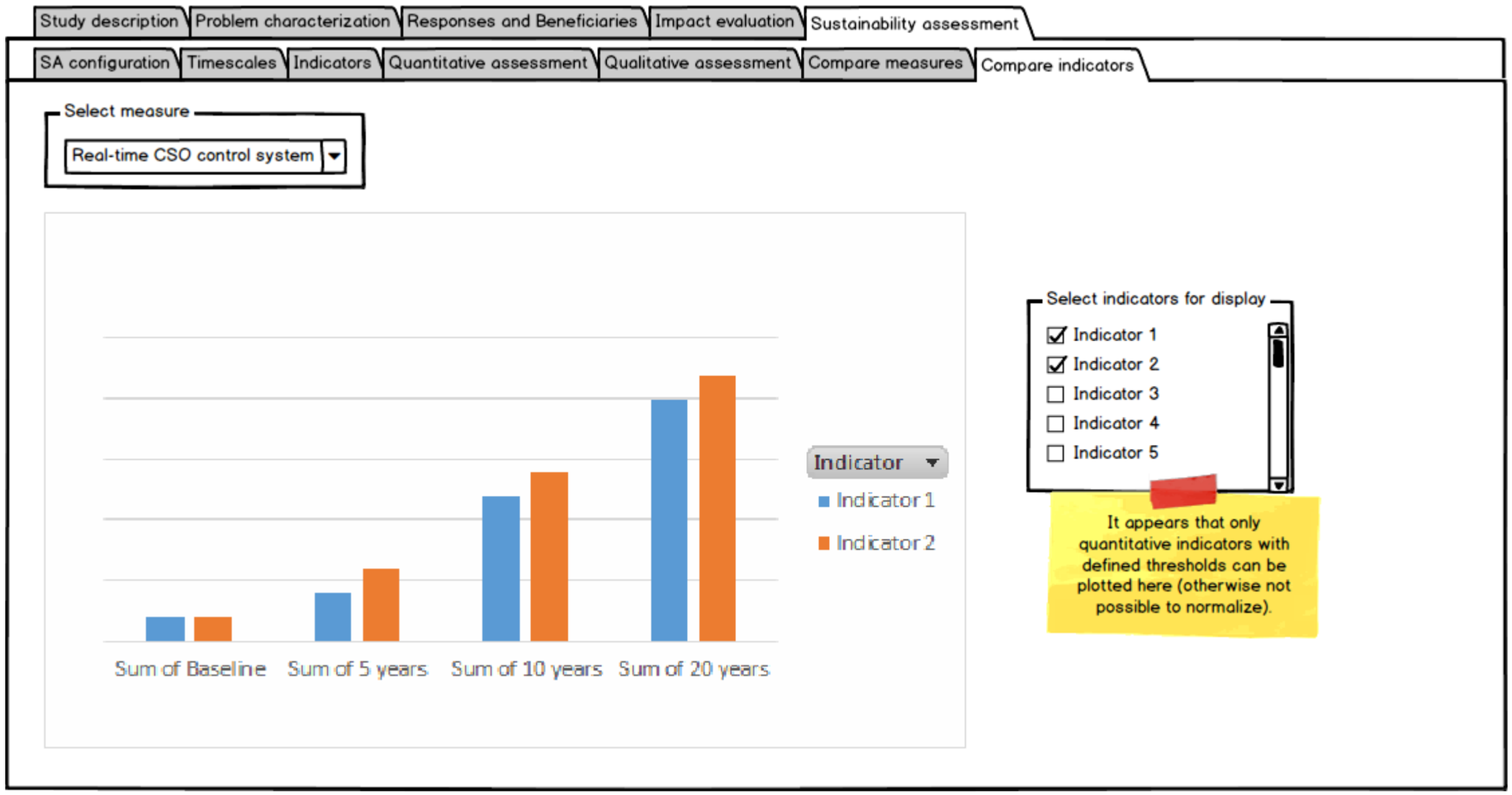

Figure 38 User story 5.12a: Visualization of results

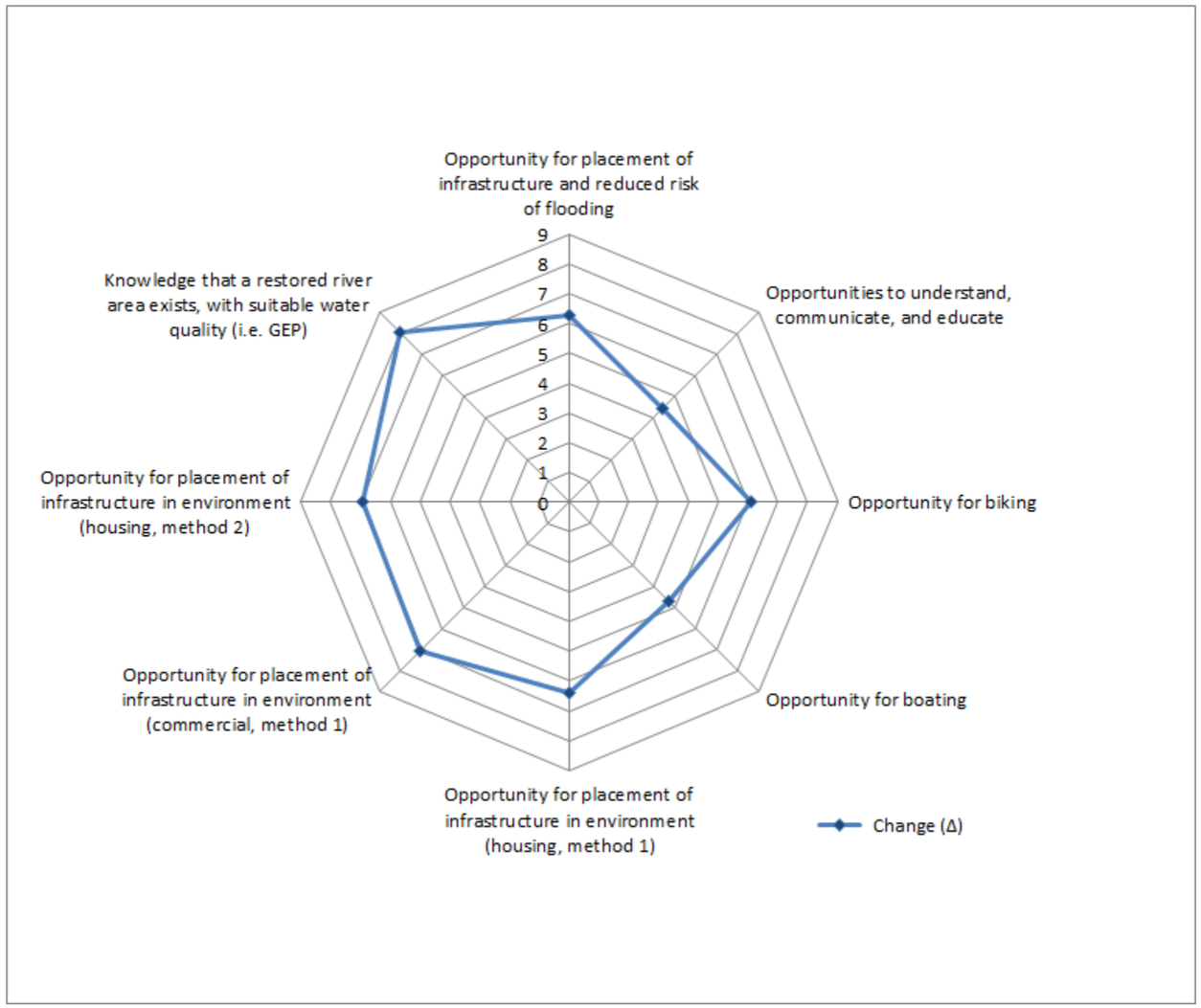

Figure 39 User story 5.12b: Visualization of results, spider diagram

7 Conclusion

The software specifications document presented here represents the consensus of partners involved in DESSIN Work Package 23: Software Framework for ESS valuation. Partners include parties involved in the development of the DESSIN ESS evaluation framework (WA1) as well as partners who will apply the software tool as part of the implementation of the Demo cases (WA3).

Because the software requirements have been developed in close consultation with the developers of the ESS evaluation framework as well as the end user group, it is anticipated that the resulting software tool will be useful to the Demo site partners when they apply the DESSIN evaluation framework at their sites. Furthermore, the specifications team have been mindful of how the tool will be used after the conclusion DESSIN, and have attempted to create a tool that will be broadly accessible to researchers and practitioners in Europe.

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