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Spreadsheets for Environmental Footprint Analysis (SEFA)
Tutorial Exercises

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These Tutorial Exercises compile materials used in U.S. Environmental Protection Agency (EPA) training courses supporting application of EPA's ***Methodology for Understanding and Reducing a Project's Environmental Footprint*** ("Footprint Methodology") and use of EPA's Spreadsheets for Environmental Footprint Analysis (SEFA). The Tutorial Exercises, together with the companion SEFA Tutorial Workbooks, comprise EPA's SEFA Tutorial Package. Use of the methodology, SEFA, and the SEFA Tutorial Package is subject to professional judgment.

The SEFA Tutorial Package does not constitute guidance or impose legally binding requirements, nor does it confer legal rights, impose legal obligations, implement any statutory or regulatory provisions, or change or substitute for any statutory or regulatory provisions. EPA recommends that users refer to applicable regulations, policies, and guidance documents regarding selection of cleanup remedies and implementation of cleanup actions. Completion of the SEFA Tutorial Package does not constitute U.S. EPA accreditation of SEFA users in any way.

Special thanks are expressed to Karen Scheuermann, U.S. EPA Region 9, for invaluable assistance in developing SEFA training sessions delivered in U.S. EPA regional offices, public seminars and workshops and in compiling the SEFA Tutorial Exercises.

Part A
Introduction

Introduction to the SEFA Tutorial Package

The U.S. Environmental Protection Agency (EPA) Spreadsheets for Environmental Footprint Analysis (SEFA) is a set of Excel workbooks for performing environmental footprint analyses at cleanup sites. The SEFA Tutorial Package was prepared by EPA to assist the new user in understanding the basics of SEFA. The Tutorial Package consists of two components: Tutorial Workbooks and Tutorial Exercises. The Tutorial Workbooks consist of SEFA populated with data for a hypothetical cleanup site. The Tutorial Exercises (described in detail below) guide the user through the SEFA Tutorial Workbooks and data entry in SEFA. The SEFA Tutorial Package is posted on EPA's CLU-IN website at: clu-in.org/greenremediation/methodology/#SEFA .

Familiarity with Excel Software: SEFA allows the user great flexibility in modeling cleanup remedies. In order to access this flexibility, the user inputs data directly into the Excel-based SEFA Workbooks. To gain the most benefits from this Tutorial Package, you should be comfortable working with the basic functions of Excel spreadsheets.

SEFA Tutorial Exercises

The SEFA Tutorial Exercises will help the user understand the basics of SEFA. There are five parts to the Tutorial Exercises, noted below. Expected time to complete each part is noted in parentheses.

Part A: Introduction (*5 minutes*)

Part B: Downloading and Opening of the SEFA Tutorial Workbooks (*10 minutes*)
This is an important first step in using the SEFA Workbooks.

Part C: Guided Tour of the SEFA Tutorial Workbooks (*30 minutes*)
Provides an orientation in the SEFA Tutorial Workbooks for the new user.

Part D: Hands-On Workshop for Data Entry in SEFA (*1½ to 2 hours*)
Helps the user become familiar with data entry for key aspects of the SEFA Workbooks.

Part E: Advanced Resources (*5 minutes*)
Provides resources for advanced features in SEFA and notes for beginning a footprint analysis at your site.

Questions or Comments

For questions or comments on the SEFA Tutorial Package or SEFA in general, please contact:

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Part B
Downloading and Opening of the SEFA Tutorial Workbooks

Introduction

SEFA consists of three Excel workbooks. For this Tutorial, the workbooks have been populated with information on a hypothetical cleanup site. The Tutorial Workbooks are:

SEFA_Tutorial_Main_(083114).xlsx
SEFA_Tutorial_Input_(083114).xlsx
SEFA_Tutorial_Calculations_(083114).xlsx

Step 1: Download the Tutorial Workbooks

Instructions:

a) Access the SEFA Tutorial Workbooks on EPA's CLU-IN website at: clu-in.org/greenremediation/methodology/#SEFA
b) Create a file folder on your computer.
c) Download the three Tutorial Workbooks ("SEFA Tutorial Main (083114)," "SEFA Tutorial Input (083114)," and "SEFA Tutorial Calculations (083114)") into the folder.
d) Do not rename the Tutorial Workbooks when downloading them.

Notes:

→ Some computer systems will add suffixes to file names when downloading. If this occurs, return the file names to their original format (listed above).
→ Blank versions of the SEFA Workbooks are also available on EPA's CLU-IN website. Do not use the blank versions of SEFA for the Tutorial Exercises.
→ Some computers will automatically download files into a "Downloads" folder as a default. If that occurs, move the three Tutorial Workbooks into the file folder you created under Step 1 b.

Step 2: Open the Workbooks

Instructions:

a) Open all three SEFA Tutorial Workbooks.
b) Open the workbooks directly from the folder on your computer that you created under Step 1 b.
c) Be sure to enable the macroinstructions ("macros") if prompted.

Notes:

→ All three workbooks must be open at the same time to exchange information.

→ The workbooks may not function properly if opened from the CLU-IN website or from an email.

→ Some computer systems may not prompt for enabling of macros and others may automatically enable the macros. Please be sure that the macros are enabled even if not prompted.

Step 3: Confirm that the Workbooks are Functioning Properly

Instructions:

a) View the "General" tab in each workbook.

b) Check Row 15 in the "General" tab of the Main Workbook, and Row 13 in the "General" tab of the Input Workbook and the Calculations Workbook.

c) If an error message appears in these locations on any of the three "General" tabs, the workbooks are not functioning properly. Correct the situation as noted below.

Notes:

→ If an error message occurs, check the following items and make corrections as needed:

- One of the three workbooks may not be open. Be sure to open all three workbooks.
- The workbooks may have been renamed (perhaps inadvertently) during downloading. Close the workbooks, return the names to their original format, and reopen the workbooks.
- The workbooks may have been opened from the CLU-IN website or from an email. Be sure to open the workbooks directly from a file folder located on your computer.
- The macros may not have been enabled. Be sure to enable the macros.

→ The "General" tabs are located at the beginning of each workbook. Identify the "General" tabs using the named tabs along the lower edge of the workbook.

Conclusion

Once you have confirmed that the workbooks are functioning properly, you are ready to begin Part C (the Guided Tour) to become familiar with the worksheets in SEFA.

Part C
Guided Tour of the SEFA Tutorial Workbooks

Introduction

The SEFA Tutorial Workbooks are set up for a hypothetical site. The site is called "Green Hills" and the remedy is "Dig & Haul." The remedy includes the following activities: site investigation; excavation of contaminated soil; transport of the soil off-site; backfilling the excavated areas; operation of a pump and treat system; and conducting groundwater monitoring.

In the Guided Tour you will access worksheets and view them, in order to become familiar with the way the workbooks are arranged. You will not be asked to enter data into the SEFA Workbooks during the Guided Tour. Data entry will begin in Part D of the Exercises.

Overview of the SEFA Workbooks

The SEFA Workbooks provide the following functions:

Main Workbook

- Allows entry of basic information about the site.
- Provides key outputs in tabular and chart format.

Input Workbook

- Primary data entry tabs for detailed information about remedy activities.
- Secondary data entry tabs for user flexibility in specifying site-specific parameters.

Calculations Workbook

- Performs footprint calculations.
- Compiles intermediate results.

Step 1: Visit the "General" Tabs in All Three Workbooks

Each of the three workbooks has a "General" tab, color-coded yellow. A few basic items of data entry are performed in the "General" tabs, as described below.

Instructions:

a) Visit the "General" tab in the Main Workbook. Note that basic information has been entered for the hypothetical site, such as site name, remedy name, remedy components, and a narrative overview of the site and remedy.

> ***Notes:***
> → Site name "Green Hills" and remedy name "Dig & Haul" have been entered for this Tutorial.
> → Six Remedy Components have been set up for this Tutorial to reflect the various activities in the remedy.
> → A narrative description of the hypothetical site has been added at the bottom of the page.

b) Visit the "General" tabs in the Input Workbook and the Calculations Workbook. Note that the site name, remedy name, and remedy components are automatically populated in these tabs.
c) View the "General" tabs in all three Workbooks to check for the information that links the workbooks. The linkages are found in Row 13 of the "General" tab in the Main Workbook, and Row 11 of the "General" tabs in the Input Workbook and Calculations Workbook.

> ***Notes:***
> → To function properly, the three workbooks must be linked through the file names entered in the "General" tabs in each of the Workbooks.
> → When setting up the SEFA Workbooks for the first time, the user types the file names into the "General" tabs of each of the Workbooks.
> → The file names have already been entered for this Tutorial.

Step 2: Visit the Primary Data Entry Tabs in the Input Workbook

The primary data entry tabs are located in the Input Workbook. They are the "Input Summary" and the "Input Template" tabs (color-coded yellow), and any copies the user makes of the "Input Template" tab. The user makes copies of the "Input Template" tab to reflect remedy activities and enters specific remedy data into the new tabs.

Instructions:

a) Visit the "Input Template" tab in the Input Workbook.
b) Scroll through all three pages of the tab to briefly view the types of data entry offered. (There is no need for a detailed review of the tab at this time.)

> ***Notes:***
> → The "Input Template" tab has three pages of tables for data entry.
> → All the tables are blank.
> → The user makes as many copies of the "Input Template" tab as needed to model the remedy activities.

c) Visit several of the Input tabs created for this Tutorial. The Input tabs are in the Input Workbook and are called Site Investigation, Excavation, Soil Sent Off-Site, Backfill, Pump and Treat, and Groundwater Monitoring.
d) Page through several of these tabs to briefly view the types of data that have been entered for this Tutorial. (There is no need for a detailed review of the data at this time.)

> ***Notes:***
> → For this Tutorial, six copies have been made of the "Input Template" tab.
> → The copies are new Input tabs and have been renamed to reflect the remedy activities of the "Green Hills" hypothetical site: Site Investigation, Excavation, Soil Sent Off-Site, Backfill, Pump and Treat, and Groundwater Monitoring.
> → Information has been entered in the new Input tabs to reflect the remedy activities.
> → A new copy of the "Input Template" tab will be added and data will be entered during Part D of these Exercises.

e) Visit the "Input Summary" tab in the Input Workbook.
f) Scroll down this tab to briefly view the format for summarizing the input data.

> ***Notes:***
> → The "Input Summary" tab summarizes the numerical data from the six Input tabs (Site Investigation, Excavation, Soil Sent Off-Site, Backfill, Pump and Treat, and Groundwater Monitoring).
> → The user enters the names of the Input tabs in Row 6 of "Input Summary" tab. This has already been done for the six Input tabs that have been made for the Tutorial.
> → Empty space has been left in one column for the new Input tab that will be added during Part D of these Exercises.

Step 3: Visit the Secondary Data Entry Tabs in the Input Workbook

The secondary data entry tabs (color-coded yellow) provide flexibility to the user in modeling the remedy activities.

Instructions:
a) Visit the "Grid Electricity" tab in the Input Workbook.
b) Scroll down the worksheet.

Notes:
- → The "Grid Electricity" tab reflects an average fuel mix for grid electricity in the U.S.
- → For better accuracy, the user may specify the fuel mix for grid electricity from the local utility.
- → An example of specifying the local fuel mix will be provided during Part D of these Exercises.

c) Visit the "User Defined Factors" tab in the Input Workbook.
d) Scroll down the worksheet.

Notes:
- → SEFA is equipped with default footprint conversion factors for an array of common remedy materials and services.
- → The user may specify conversion factors unique to the site and remedy.
- → The Tutorial Workbooks include three user defined materials (lime, clean fill, and drain rock).
- → A new user defined material will be added during Part D of these Exercises.

e) Visit the "Well Material Calculator" tab in the Input Workbook.
f) Scroll down the worksheet.

Notes:
- → This calculator assists the user in estimating the amounts of materials used in well construction.
- → The calculator is not used in the Tutorial Exercises.

Step 4: Visit Key Output Tabs in the Main Workbook

The key output tabs (color-coded blue) provide outputs in tabular and chart format. These outputs reflect the protocol and footprint metrics suggested in EPA's Footprint Methodology (found at clu-in.org/greenremediation/methodology).

Instructions:
a) Visit the "Summary" tab in the Main Workbook.
b) Scroll down the worksheet.

> ***Notes:***
> → The "Summary" tab provides results in tabular format for all footprint metrics for each Remedy Component.

c) Visit the "Totals by Scope and Component" tab in the Main Workbook.
d) Scroll down the worksheet, and scroll across to the right.

> ***Notes:***
> → This tab provides charts based on Scopes 1, 2, 3, and 3a (as defined in EPA's Footprint Methodology) for each Remedy Component.
> → The charts are provided for the following metrics: energy, greenhouse gas emissions, and emissions of NOx, SOx, PM, and hazardous air pollutants (HAPs).

Step 5: Visit Tabs with Intermediate Results

Several tabs in the SEFA Workbooks provide intermediate results. The tabs (color-coded blue) are the "Component" tabs in the Calculations Workbook and the "Energy & Air" tabs in the Main Workbook.

Instructions:

a) Visit a few of the "Energy & Air" tabs in the Main Workbook and "Component" tabs in the Calculations Workbook.
b) Briefly scroll through the tabs to view the data tables.

> ***Notes:***
> → The tabs perform the functions of data processing and compiling in SEFA.
> → The user can view and access intermediate results from these tabs.
> → Intermediate results can help the user understand the contributors to the footprint metrics.

Step 6: Visit "Intro," "Instructions," "Notes," and "Explanation" Tabs

These tabs (color-coded green) are located in all three Workbooks. The tabs assist the user with basic information about SEFA, give specific instructions for data entry, and provide explanations of how the workbooks function. There is no need to read these tabs at this point, but you may want to visit them after finishing the Tutorial.

Instructions:

a) Look for the "Intro," "Instructions," "Notes," and "Explanation" tabs in the three Workbooks.
b) Open a few of the tabs if desired to briefly view the contents.

Step 7: Note the "Behind the Scenes" Tabs

These tabs (color-coded gray) are located in the Input and Calculations Workbooks. The tabs contain look-up tables and default footprint conversion factors, and perform data transfer functions. There is no need to view these tabs at this point. Some users may want to access the information in these tabs when conducting a footprint analysis, to understand the default values used in SEFA or to view references for footprint conversion factors.

Conclusion

This completes the "Guided Tour" of SEFA. You are now ready to begin the Part D (the Hands-On Workshop) to become familiar with entering data in the SEFA worksheets.

Part D
Hands-On Workshop for Data Entry in SEFA

The Hands-On Workshop demonstrates three key features in SEFA: adding a new activity to the remedy, changing the fuel mix for grid electricity, and adding a new remedy material. Additional features and options are also demonstrated, including: use of renewable energy sources, modeling carbon storage, and testing alternative modes of transport and fuels.

We recommend following the Workshop in the order presented, because many of the items build on previous steps. The items in the Hands-On Workshop are listed below with the estimated time required to complete each item.

Key Features in SEFA

Item 1: Add a New Activity to the Remedy (*30 minutes*) page 14

Item 2: Change the Fuel Mix for Grid Electricity (*5 minutes*) page 25

Item 3: Add a New Remedy Material (*10 minutes*) page 27

Additional Features and Options

Item 4: Renewable Energy (*5 minutes*) page 30

Item 5: Carbon Storage in Trees (*5 minutes*) page 32

Item 6: Train vs Truck Transport (*5 minutes*) page 34

Item 7: Biodiesel vs Diesel Fuel (*10 minutes*) page 37

Item 8: Laboratory Analyses (*5 minutes*) page 39

Item 9: Rename the Workbooks (*10 minutes*) page 41

Notes:

The Tutorial Workbooks and the Hands-On Workshop present a hypothetical remedy for the purpose of demonstrating basic features in SEFA. Information entered in SEFA for this Tutorial is hypothetical and should not be used as a basis for footprint analyses at real sites.

Data entry items in the Hands-On Workshop (following pages) are noted in yellow highlight.

Item 1: Add a New Activity to the Remedy

Scenario:
The remedy at the hypothetical "Green Hills" site includes excavating contaminated soil, sending it off-site for disposal, and backfilling the excavated area. We now realize that regrading will be necessary following the backfilling at the site. We will add a new worksheet to the Input Workbook to model the regrading activities. In our results, we would like the regrading activities to be compiled with the backfilling activities. Therefore, we'll link the new Regrade worksheet to the Backfill remedy component.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to General tab
c) Note "Component 4: Backfill" (Row 21)

Notes:
→ When we set up the new worksheet for Regrading activities, we'll link the worksheet to Remedy Component 4.

Instructions:
Still in Main Workbook
d) Go to Summary tab
e) Jot down the value for Total Greenhouse Gas Emissions for Backfill (Cell H34)

Notes:
→ The greenhouse gas estimate will change when regrading activities are added to Remedy Component 4 (Backfill).

Step 2: Add a New Worksheet for Regrading Activities

Instructions:

a) Go to Input Workbook
b) Make a copy of Input Template tab
c) Relocate new tab just after "Backfill" tab
d) Name new tab: Regrade
e) Go to drop-down menu in Cell E4 and select "Component 4"

Notes:

→ This links the new worksheet (Regrade) to Remedy Component 4 (Backfill).
→ The new Regrade worksheet can be located anywhere in the Input Workbook. We have placed it near the "Backfill" tab for convenience.

Step 3: Add General Information to the Regrade Worksheet

Instructions:

Still in Input Workbook, Regrade tab

a) Go to General Scope (Row 7)
b) Type in Cell A8: Regrade site after backfilling.

Notes:

→ There is also space at the top of the worksheet for narrative remarks regarding items that have been screened out of the footprint analysis (Cell I8), and for other notes and references (Cell Q8).

Step 4: Add Personnel Transportation Data to the Regrade Worksheet

Instructions:

Still in Input Workbook, Regrade tab

a) Go to Personnel Transportation (Row 14)
b) Enter data in Row 16:

Participant	Number of Roundtrips to Site	Roundtrip Distance to Site (miles)	Mode of Transport	Transport Fuel Type
regrading crew	20	50	light duty truck	diesel

Notes:

→ The worksheet calculates total distance (Column H), selects a default fuel usage rate (Column I), and calculates total fuel used (Column K).
→ Fuel usage rate override (Column J) can be used for specific fuel efficiencies.
→ There is ample space for more personnel trips (Rows 17 – 26).
→ Rows 25 & 26 are available for unique transportation situations.

Step 5: Add Equipment Data to the Regrade Worksheet

Instructions:
Still in Input Workbook, Regrade tab
a) Go to On-Site Equipment Use and Transportation (Row 29)
b) Enter data in Row 31:

Equipment Type	HP (horsepower)	Load Factor (%)	Equipment Fuel Type	Equipment Hours Operated	Number of Roundtrips to Site	Roundtrip Distance to Site (miles)	Transport Fuel Type
Grader (175 hp)	175	75	diesel	125	1	50	diesel

Notes:
→ For equipment operation, the worksheet selects a default fuel usage rate (Column F) and calculates total fuel used (Column H).
→ For equipment transport to the site, the worksheet calculates total distance (Column K), selects a default fuel usage rate (Column M), and calculates total fuel used (Column O).
→ Fuel usage rate override (Column N) can be used for specific fuel efficiencies.
→ There is ample space for more equipment (Rows 32 – 40).
→ Rows 39 & 40 are available for unique equipment situations.
→ There is space for notes in Column P.
→ The load factor (Column D) is explained in the "Detailed Notes and Explanations" tab in the Input Workbook.

Step 6: Add Electricity Usage Data to the Regrade Worksheet

Instructions:
Still in Input Workbook, Regrade tab
a) Go to On-Site Electricity Use (Row 43)
b) Enter data on Row 45:

Equipment Type	HP (horsepower)	Load Factor (%)	Efficiency (%)	Hours Used
dewatering pump	5	80	75	80

Notes:
→ Rows 45 - 48 allow data entry for equipment with known horsepower and hours used.
→ The worksheet calculates the electrical rating (Column E) and energy used (Column G).
→ The load factor and efficiency (Columns C and D) are explained in the "Detailed Notes and Explanations" tab in the Input Workbook.

Instructions:
Still in Input Workbook, Regrade tab
Still at On-Site Electricity Use (Row 43)
c) Enter data on Row 49:

Equipment Type	Electrical Rating (kW)	Hours Used
outdoor lighting (floodlights)	10	40

Notes:
→ Rows 49 - 52 allow data entry for equipment with known electrical rating and hours used.
→ The worksheet calculates the energy used (Column G).

Instructions:
Still in Input Workbook, Regrade tab
Still at On-Site Electricity Use (Row 43)
d) Enter data on Row 53:

Equipment Type	Energy Used (kWh)
portable office space	120

Notes:
→ Rows 53 - 56 allow data entry for equipment with known electrical usage in kWh.

Instructions:
Still in Input Workbook, Regrade tab
Still at On-Site Electricity Use (Row 43)
e) Enter data on Row 58 for Renewable Electricity Generated On-Site:

Energy Used (kWh)	Notes
500	solar panels on office roof

Notes:
→ Although Column G is titled "Energy Used," we enter in Cell G58 the kWh of electrical energy generated from renewable sources.
→ The formula in Cell G59 subtracts Cell G58 from Cell G57 for grid electricity demand. This assumes that the renewable electricity generated on-site offsets the grid electricity demand of on-site activities.

Step 7: Add Materials Data to the Regrade Worksheet

Instructions:
Still in Input Workbook, Regrade tab
a) Go to Materials Use and Transportation (Row 65)
b) Enter data on Row 67:

Material Type	Quantity	Refined or Unrefined	Virgin, Recycled, or Reused	Calculate Item Footprint	One-way Distance Override (miles)	Number of One-way Trips to Site	Mode of Transport	Transport Fuel Type	Notes
gravel/sand /clay	300,000	unrefined	virgin	yes	20	150	truck (mpg)	diesel	sand used in regrading

Notes:
- → The characterizations in Columns F, G, and H (refined/unrefined; virgin/recycle/reused; footprint/no footprint) are site-specific and material-specific.
- → The user determines the correct characterization for the site and material and makes selections from the drop-down menus.
- → The "Detailed Notes and Explanations" tab in the Input Workbook provides background information on these characterizations.
- → Entering the value "20" for "One-way Distance Override" in Cell J67 overrides the default distance of 25 miles in Cell I67. The override value of 20 miles is used in subsequent calculations in SEFA, even though the default distance of 25 miles remains in Cell I67.
- → There is ample space for additional materials (Rows 68 - 84).
- → User may add user-defined materials to the drop-down menu. This is demonstrated later in the Hands-On Workshop.

Instructions:
Still in Input Workbook, Regrade tab
Still at Materials Use and Transportation (Row 65)
c) Enter data on Row 68:

One-way Distance Override (miles)	Number of One-way Trips to Site	Mode of Transport	Transport Fuel Type	Fuel Usage Rate Override (gptm or mpg)	Notes
20	150	truck (mpg)	diesel	7	return trip empty

Notes:
→ This adds an empty return trip for the truck transport.
→ Leave Cells A68 - I68 blank.

Step 8: Add Waste Data to the Regrade Worksheet

Instructions:
Still in Input Workbook, Regrade tab
a) Go to Waste Disposal and Transportation (Row 90)
b) Enter data in Row 92:

Waste Destination	Quantity	One-way Distance Override (miles)	Number of One-way Trips to Site	Mode of Transport	Transport Fuel Type	Notes
recycled/ reused off-site	50	30	3	truck (mpg)	diesel	concrete sent off-site for reuse

Notes:
→ There is ample space for additional wastes (Rows 93 - 103).
→ User may add user-defined waste options to the drop-down menu, in a manner similar to user-defined materials noted above.

Instructions:
Still in Input Workbook, Regrade tab
Still at Waste Disposal and Transportation (Row 90)
c) Enter data on Row 93 for the return empty trip, using the same approach as for the empty return trip in Row 68 for Materials.

Step 9: Add Water Data to the Regrade Worksheet

Instructions:
Still in Input Workbook, Regrade tab
a) Go to Water Use (Row 108)
b) Enter data in Row 110:

Source of Water Used	Quantity	Source Location/ Aquifer	Quality of Water Used	Water Uses	Fate of Used Water
public water	4,000	municipal utility district	potable	dust suppression	evaporation

Notes:
- → The units for quantity of water are "gal x 1000." Therefore, the entry of 4,000 in Column D represents 4,000,000 gallons of water.
- → Comments entered in Columns F - V are not used in the footprint analysis. The comment cells are provided for user convenience only.
- → There is ample space for additional water usage (Rows 111 - 121).

Step 10: Link New Regrade Tab to Input Summary Tab

Instructions:
Still in Input Workbook

a) Go to Input Summary tab
b) Go to Cell G6
c) Type the tab name: Regrade

Notes:

- → This causes Column G to be populated with data from the new "Regrade" tab.
- → The user must fill in the headings in Row 6 in order for the information in each tab to be included in the footprint analysis.
- → The entries in Row 4 remind us to which Remedy Component we have linked each tab. These entries are populated automatically, based on the selection we made in Cell E4 of each Input tab.
- → The manual linking of the Input tabs to the Input Summary tab provides the user flexibility in setting up unique structures and comparisons for each footprint analysis.
- → Columns J - P are not used for this hypothetical site, and can be "hidden" for a more compact table.

Step 11: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Backfill (Cell H34)

Notes:

- → The greenhouse gas estimate has increased due to the regrading activities that were added to the Backfill component (via the addition of the "Regrade" tab).

Instructions:
Still in Main Workbook
d) Go to General tab
e) Go to Row 21 (Component 4)
f) Rename Component 4: Backfill and Regrade

Notes:
→ The new name for Remedy Component 4 more accurately describes the activities.

Instructions:
Still in Main Workbook
g) Go to Summary tab
h) Go to Column H

Notes:
→ The heading to Column H (Cell H6) has been automatically populated with the new Remedy Component name (Backfill and Regrade).

Step 12: Revisit Input Workbook

Instructions:
a) Go to the Input Workbook
b) Go to Backfill and Regrade tabs
c) Go to Cell G4 in each of the tabs

Notes:
→ The new Remedy Component name has been automatically populated in Cell G4 on these tabs and in other locations as needed on all worksheets in all three workbooks.

Item 2: Change the Fuel Mix for Grid Electricity

Scenario:
The default fuel mix provided in SEFA for grid electricity is the U.S. national average for 2009. We will change the fuel mix to reflect the local utility provider for our hypothetical "Green Hills" site.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:
→ The greenhouse gas estimate will change when the fuel mix is changed.

Step 2: Enter Fuel Mix for Local Grid Electricity Provider

Instructions:
a) Go to Input Workbook
b) Go to Grid Electricity tab
c) Change values in Column B

Coal:	1%	Geothermal:	5%
Natural gas:	43%	Hydro:	18%
Oil:	1%	Solar:	1%
Nuclear:	24%	Wind:	3%
Biomass:	4%	Other:	0%

Notes:
→ The default fuel mix is documented in Column N for purposes of comparison.
→ The user may specify the fuel mix separately for each Remedy Component, as described in the instructions at the bottom of the "Grid Electricity" tab.
→ When adding a new fuel mix to the "Grid Electricity" tab, the user will be responsible for obtaining and documenting the new data.

Instructions:
Still in Input Workbook, Grid Electricity tab

d) Go to Row 32 (Notes and References)
e) Add a reference for the fuel mix in Cell A33: Fuel Mix for Pacific Gas & Electric (2010).
Source: www.pge.com/myhome/edusafety/systemworks/electric/energymix/

Step 3: Visit Calculations Workbook

Instructions:

a) Go to Calculations Workbook
b) Go to Grid Electricity Conversions tab
c) No data entry in this tab – we are visiting this tab for observation only

Notes:

→ The conversion factors for grid electricity are calculated in the "Grid Electricity Conversions" tab, based on the fuel mix entered in the Input Workbook.
→ The local fuel mix has been automatically transferred into Column B of the "Grid Electricity Conversions" tab.
→ The conversion factors representing the local fuel mix are calculated in Row 17 and will be applied automatically to all electricity use at the site.

Step 4: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:

→ The greenhouse gas estimate has decreased due to the smaller footprint of the new fuel mix.
→ The new fuel mix has a smaller greenhouse gas footprint because it is lower in coal and higher in natural gas and renewables than the original default fuel mix.

Item 3: Add a New Remedy Material

Scenario:
In the Pump and Treat system at the "Green Hills" site, we've used the default conversion factors provided in the SEFA workbooks for treatment chemicals. However, we have now estimated conversion factors for the actual treatment chemical we're using. It's called "Treatment Mix ABC" and we'll add this new material to the worksheets.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:
→ The greenhouse gas estimate will change when the new conversion factors are entered.

Step 2: Visit the Materials Drop-Down Menu

Instructions:
a) Go to Input Workbook
b) Go to Pump and Treat tab
c) Go to Materials Use and Transportation (Row 65)
d) On Row 67, open the drop down menu in Column A and scroll through entire menu
e) Leave the drop-down selection at "Other Treatment Chemicals & Materials."

Notes:
→ We are now using the generic "Other Treatment Chemicals & Materials" selection from the drop-down menu.
→ There are empty placeholder activities (called "User-defined materials") at the end of the drop-down menu.
→ In the next step, we will set up a new remedy material (Treatment Mix ABC) using the empty placeholder "User-defined Material #4" in the drop-down menu.
→ For the moment, be sure to leave the drop-down selection at "Other Treatment Chemicals & Materials."

Step 3: Set Up a New Remedy Material (Treatment Mix ABC)

Instructions:
Still in Input Workbook
a) Go to User Defined Factors tab
b) Go to Row 19 (User-defined material #4)
c) Enter data:

User Defined Activity, Material, or Service	Unit	Tons per Unit	Energy (MMBtu/ unit)	GHG (lbs CO2e/ unit)	NOx (lbs/unit)	SOx (lbs/unit)	PM (lbs/unit)	HAPs (lbs/unit)	Ref.
Treatment Mix ABC	lb	0.0005	0.05	8.1	0.06	0.053	0.008	0.0012	4

Notes:
→ The data entered for GHG, NOx, SOx, PM, and HAPs are footprint conversion factors.
→ The new footprint conversion factors are higher than the default conversion factors for "Other Treatment Chemicals & Materials."

Instructions:
Still in Input Workbook, User Defined Factors tab

d) Go to Row 67 and add a reference for the new material:

"Ref 4: Treatment Mix ABC is a fictitious material added for the purposes of this Tutorial. Do not use these conversion factors for real footprint analyses."

Notes:

→ When adding new footprint conversion factors to the "User Defined Factors" tab, the user will be responsible for obtaining and documenting the new data.

→ User defined factors for up to 20 materials may be added by the user.

→ Other user defined factors (e.g., for fuel combustion and off-site waste management) can also be added on the "User Defined Factors" tab. Instructions for adding these factors are provided at the bottom of the tab.

Step 4: Select the New Remedy Material (Treatment Mix ABC) from the Drop-Down Menu

Instructions:
Still in Input Workbook

a) Go to Pump and Treat tab
b) Go to Materials Use and Transportation (Row 65)
c) On Row 67, select the newly added Treatment Mix ABC from the drop-down menu to replace "Other Treatment Chemicals & Materials."

Notes:

→ Do not make changes to other data in Row 67.

Step 5: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:

→ The greenhouse gas estimate has increased due to the higher footprint conversion factors for "Treatment Mix ABC" versus the default "Other Treatment Chemicals & Materials."

Item 4: Renewable Energy

Scenario:

We notice that the greenhouse gas footprint for the Pump and Treat component is big. We would like to buy Renewable Energy Credits (RECs) to "off-set" or reduce the footprint.

WARNING:

- → In EPA's Footprint Methodology, purchasing of RECs does not off-set the greenhouse gas footprint of the remedy. That is, the RECs are not used to reduce the greenhouse gas emissions attributed to the cleanup remedy.
- → The purchase of RECs can be entered in SEFA, and will be documented as a purchase only, without reducing either the greenhouse gas emissions or other emissions such as NOx and SOx.
- → Although not used in SEFA for emissions off-sets at a specific site, purchase of RECs can still have beneficial value, such as helping the renewable energy market to grow.

Step 1: Prep

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Go to Column I (Pump and Treat)
d) Note the value for Voluntary Purchase of RECs (Cell I25)
e) Jot down the value for Total Greenhouse Gas Emissions (Cell I34)

Notes:

- → The greenhouse gas emissions will not change when the RECs purchases are added to the worksheets.

Step 2: Enter Data on RECs Purchased

Instructions:

a) Go to Input Workbook
b) Go to Pump and Treat tab
c) Go to Other Voluntary Renewable Energy Use (Row 149)
d) Enter data in Row 156 (Voluntary purchase of RECs):

Quantity (MWh): 50

e) Go to Description of purchased RECs (Cell M153)
f) Enter data (Cells T153 – T156):

Provider: Easy-Buy RECs
Type of renewable energy source: Wind Power
Date of renewable system installation: 2012
Location of renewable system installation: Wyoming

Step 3: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Go to Column I (Pump and Treat)
d) Note the values for Voluntary Purchase of RECs (Cell I25) and Total Greenhouse Gas Emissions (Cell I34)

Notes:

→ The total for RECs changes to reflect the RECs purchased.
→ The estimate for greenhouse gas emissions does not change, because in EPA's Footprint Methodology, purchasing RECs does not off-set the greenhouse gas footprint of a cleanup remedy.

Item 5: Carbon Storage in Trees

Scenario:
As part of the regrading effort, we will plant 500 cottonwood trees at the "Green Hills" site. We would like to model the carbon storage of these trees over the next 20 years.

Notes:
- → EPA's Footprint Methodology allows the carbon storage of the trees to off-set the greenhouse gas footprint. That is, the carbon storage reduces the total greenhouse gas emissions from the cleanup remedy.
- → SEFA does not automatically model the carbon storage expected due to the growth of the trees. However, EPA's Footprint Methodology provides recommendations for modeling the carbon storage. Once you have modeled the carbon storage from the trees, SEFA allows you to input the results.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Backfill and Regrade (Cell H34)

Notes:
- → The greenhouse gas estimate will change when the trees are added.

Step 2: Enter Data on Carbon Storage in Trees

Instructions:

a) Go to Input Workbook
b) Go to Regrade tab
c) Go to Other Energy Use and Air Emissions (Row 129)
d) Enter data for On-site carbon storage (Row 136):

Quantity (lbs CO2e)	Notes
-50,000	Planting 500 cottonwood trees, growing for 20 years

Notes:

→ Carbon storage is indicated by using a negative sign in the entry.

Step 3: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Backfill and Regrade (Cell H34)

Notes:

→ The greenhouse gas estimate has decreased due to the carbon storage by the trees.

Item 6: Train vs Truck Transport

Scenario:
We have found an alternate hazardous waste landfill which is served by rail lines. We think shipping waste from the "Green Hills" site by rail instead of truck will lower our greenhouse gas footprint. However, we're not sure, because the distance to the alternate landfill (1,000 miles one way) is greater than the distance to the original landfill (680 miles one way). We'll model the rail transport to find out if it has a lower greenhouse gas footprint.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Soil Sent Off-Site (Cell G34)

Notes:
→ The greenhouse gas estimate will change when waste transport is changed from truck to rail.

Instructions:
d) Go to Input Workbook
e) Go to Soil Sent Off-Site tab
f) Go to Waste Disposal and Transportation (Row 90)
g) Jot down the fuel usage for transport to the off-site hazardous waste landfill (Cell N92) and the empty return trip (Cell N93)

Notes:
→ The fuel usage will change when the waste transport is changed from truck to rail.

Step 2: Change Mode of Transport from Truck to Train

Instructions:
Still in Input Workbook, Soil Sent Off-Site tab

a) Enter data (Row 92):

One-Way Distance Override (miles)	Number of One-way Trips to Site	Mode of Transport
1,000	n/a	Train (gptm)

b) Do not change any other data in Row 92
c) Note the new fuel usage for transport of hazardous waste (Cell N92)

Notes:
- → There is a significant reduction in fuel usage in transport by train to the landfill (Cell N92), even though the distance is greater. This is because train transport is more efficient than truck transport, per ton of material transported.

Instructions:
Still in Input Workbook, Soil Sent Off-Site tab

d) Remove the return truck trip by deleting all entries in Row 93

Notes:
- → For truck transport of waste, it is realistic to assume an empty return trip.
- → However, for train transport, it is not realistic to assume an empty return trip.
- → For a full explanation of options for modes of transport in SEFA, see the "Detailed Notes and Explanations" tab in the Input Workbook.

Step 3: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Soil Sent Off-Site (Cell G34)

Notes:

→ The greenhouse gas estimate has decreased due to transport by train.

Item 7: Biodiesel vs Diesel Fuel

Scenario:
We may have the option to use biodiesel fuel (B20) instead of petroleum-based diesel for on-site equipment at "Green Hills." The term B20 refers to fuel that is 20% biodiesel and 80% petroleum-based diesel. We would like to estimate how the footprint will change if construction equipment for the Excavation, Backfill, and Regrade activities operated on B20 biodiesel.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Excavation (Cell F34) and Backfill and Regrade (Cell H34)

Notes:
→ These values will change when equipment fuel is changed from diesel to B20.

Step 2: Change Fuel Type from Diesel to B20 Biodiesel

Instructions:
a) Go to Input Workbook

b) Go to Excavation tab
c) Go to On-Site Equipment Use and Transportation (Row 29)
d) Change fuel for equipment operation from "diesel" to "B20" (Column E, Rows 31, 32, 33)

e) Go to Backfill tab
f) Go to On-Site Equipment Use and Transportation (Row 29)
g) Change fuel for equipment operation from "diesel" to "B20" (Column E, Rows 31 – 36)

Notes:
→ We are making this change on 3 tabs (Excavation, Backfill, and Regrade) in the Input Workbook.
→ In the On-Site Equipment Use and Transportation tables, only the fuel used for operating equipment (Column E) will be changed from diesel to B20. The fuel used for transporting equipment to the site (Column L) will remain diesel.
→ Do not change any other data in the On-Site Equipment Use and Transportation tables in the Excavation, Backfill, and Regrade tabs.

Instructions (continued):

h) Go to Regrade tab
i) Go to On-Site Equipment Use and Transportation (Row 29)
j) Change fuel for equipment operation from "diesel" to "B20" (Column E, Row 31)

Step 3: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the values for Total Greenhouse Gas Emissions for Excavation (Column F) and Backfill and Regrade (Column H).

Notes:

→ The greenhouse gas emissions have decreased. This decrease is due to the lower greenhouse gas footprint from producing biodiesel, as compared with petroleum-based diesel.

→ As an aside, the use of B20 biodiesel will also cause changes in the NOx, SOx, and PM emissions due to different production methods for biodiesel versus petroleum-based diesel.

→ The nuances of these changes can be observed by accessing the intermediate results in the Calculations Workbook.

Item 8: Laboratory Analyses

Scenario:
Process sampling is occurring at the pump and treat system at the "Green Hills" site, but we screened it out of the footprint analysis, assuming it to be a minimal contributor to the remedy footprint. We now realize that off-site laboratory analyses conducted on the process samples could be a significant contributor, and should not have been screened out. We will add the laboratory analyses to the Pump and Treat activities.

Step 1: Prep

Instructions:
a) Go to Main Workbook
b) Go to Summary tab
c) Jot down the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:
→ The greenhouse gas estimate will change when the off-site laboratory analysis is added.

Step 2: Add the Laboratory Analyses

Instructions:
a) Go to Input Workbook
b) Go to Pump and Treat tab
c) Go to Off-Site Laboratory Analysis (Row 129, Column Q)
d) Enter data in Cells Q133, T133, and U133;
and in Cells Q134, T134, and U134:

Parameter and Notes	Unit Cost ($)	Number of Samples
general chemistry	75	250
Metals	150	250

Notes:
→ The default footprint conversion factors in SEFA for laboratory analysis are based on cost of the analyses, as an indicator of economic activity. A full description and references for the conversion factors are provided in the "Default Conversions" tab in the Calculations Workbook.

Step 3: Revisit Main Workbook

Instructions:

a) Go to Main Workbook
b) Go to Summary tab
c) Note the value for Total Greenhouse Gas Emissions for Pump and Treat (Cell I34)

Notes:

→ The greenhouse gas estimate has increased due to the addition of off-site laboratory analysis.

Item 9: Rename the Workbooks

Scenario:
We've finished our footprint analysis, but now the "Green Hills" site has been sold and will be redeveloped as a golf course. The site name has been changed to "Golf Greens," so we want to rename the workbooks.

Step 1: Close and Rename the Workbooks

Instructions:

a) Close all three workbooks (save the changes made during this workshop, when prompted as you close the workbooks)
b) Replace "Tutorial" in the file name in each of the workbooks with "GolfGreens"
c) The file names will now be:

SEFA_GolfGreens_Main_(083114).xlsx
SEFA_GolfGreens_Input_(083114).xlsx
SEFA_GolfGreens_Calculations_(083114).xlsx

Notes:

→ The date in parentheses indicates the current version of the SEFA workbooks (issued 8/31/14).
→ However, when the SEFA is applied to a real site, this date can be updated in the file names by the user if needed to indicate the date or version of the footprint analysis.

Step 2: Reopen the Workbooks

Instructions:

a) Reopen all three workbooks
b) Check the "General" tabs in all three workbooks.

Notes:

→ Error messages appear in the "General" tabs in each workbook. See Row 15 in the "General" tab in the Main Workbook, and Row 13 in the "General" tab in the Input Workbook and Calculations Workbook.
→ The error messages indicate that the links among the three workbooks are no longer in place. This is because the file names for the workbooks have been changed, but the names have not been updated in the "General" tabs.
→ Error symbols also appear elsewhere in the workbooks, such as the "Summary" tab in the Main Workbook.

Step 3: Re-establish the Links in the Workbooks

Instructions:

a) Go to Main Workbook
b) Go to General tab
c) Rename the file name on Row 13:
SEFA_GolfGreens_Calculations_(083114).xlsx

d) Go to Input Workbook
e) Go to General tab
f) Rename the file name on Row 11:
SEFA_GolfGreens_Main_(083114).xlsx

g) Go to Calculations Workbook
h) Go to General tab
i) Rename the file name on Row 11:
SEFA_GolfGreens_Input_(083114).xlsx

Notes:

→ Be sure that the entries in the "General" tabs exactly match the file names.
→ The workbooks are now linked and the error messages will disappear.
→ The file names for the three SEFA Workbooks can be renamed in any way that the user wants, as long as the user enters the new file names into the "General" tabs in the Workbooks.

Step 4: Update the Site Name in the Workbooks

Instructions:

a) Go to Main Workbook
b) Go to General tab
c) Rename the site name on Row 6:
Golf Greens (Tutorial)

Notes:

→ Renaming the site in Row 6 of the "General" tab is for user convenience and does not affect the linking among workbooks.
→ The new name is automatically populated onto all worksheets of all three workbooks.

Conclusion

This completes the “Hands-On Workshop” and concludes the full SEFA Tutorial.
For recommendations on exploring advanced features of SEFA, and beginning a footprint analysis at your site using SEFA, please see Part E in these Tutorial Exercises.

Part E
Advanced Resources

Advanced Features in SEFA

Advanced features in SEFA are described in the instructions and notes tabs throughout the SEFA Workbooks. Brief instructions and notes can also be found in some of the data entry tabs. The instructions and notes will help the user take advantage of the many flexibilities within SEFA, allowing the user to model the site and remedy more accurately. All the instructions and notes tabs are listed below. The "Instructions" tab in the Main Workbook and the "Input Instructions" tab in the Input Workbook will be especially useful for the first-time user.

Main Workbook

Workbook	Tab	Contents
Main	Intro to SEFA	Description of SEFA, Overview of the Workbooks, Programming Details, Notes on Updates
Main	Instructions	Setting up the Workbooks, Entering Data, Processing and Accessing Outputs
Input	Input Instructions	Creating Input Tabs, Notes on the Grid Electricity Tab, Notes on the User Defined Factors Tab, Example of Aligning Input Tabs to Remedy Components
Input	Detailed Notes and Explanations	Notes and Recommendations for Using Each Data Entry Table on the Input Template Tab
Calculations	Notes	Overview of the Calculations Workbook, Notes on Accessing Intermediate Data
Calculations	Explanation of Grid Electricity	Illustration of How Grid Electricity is Translated into Total Energy in SEFA

Beginning a Footprint Analysis at Your Site Using SEFA

To begin a footprint analysis at your site using SEFA, download a blank copy of the SEFA Workbooks from EPA's CLU-IN website at: clu-in.org/greenremediation/methodology/#SEFA.

In the blank copy of SEFA, set up the Remedy Components in the Main Workbook and the Input Tabs in the Input Workbook, to reflect the activities at your site and to answer the questions that are important for your site. The set-up of Remedy Components and Input Tabs is flexible to accommodate a wide variety of remedy activities and site questions. For more information on setting up the SEFA Workbooks to reflect your site, see the "Instructions" tab in the Main Workbook and the "Input Instructions" tab in the Input Workbook.