Estimating Environmental Footprints Using SEFA

EPA Webinar
22 August 2013

SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Presenters

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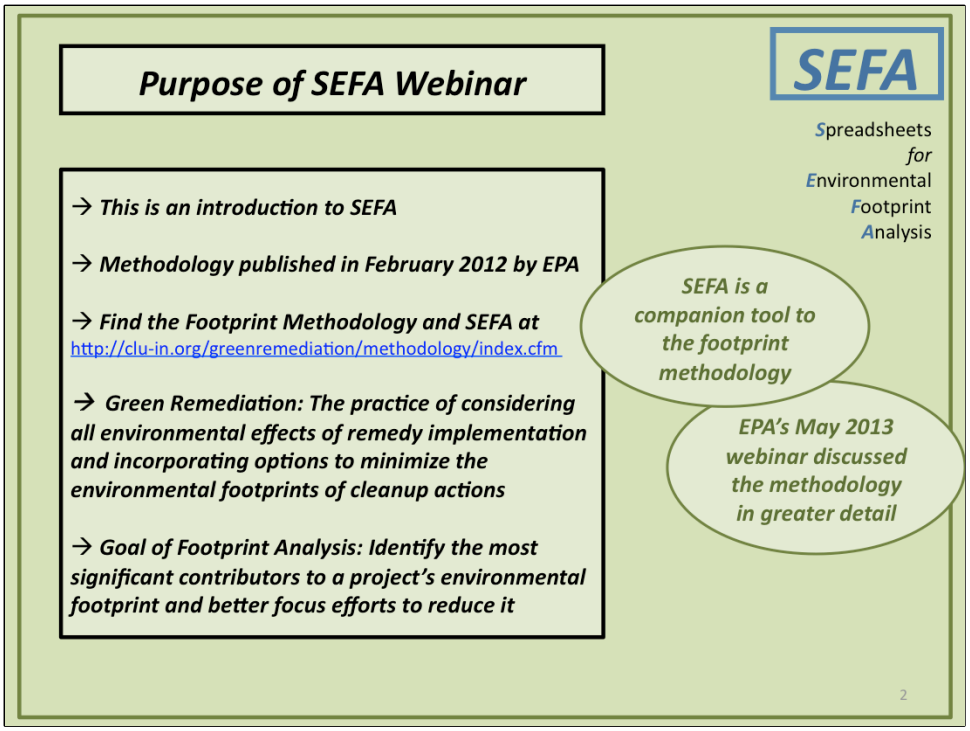
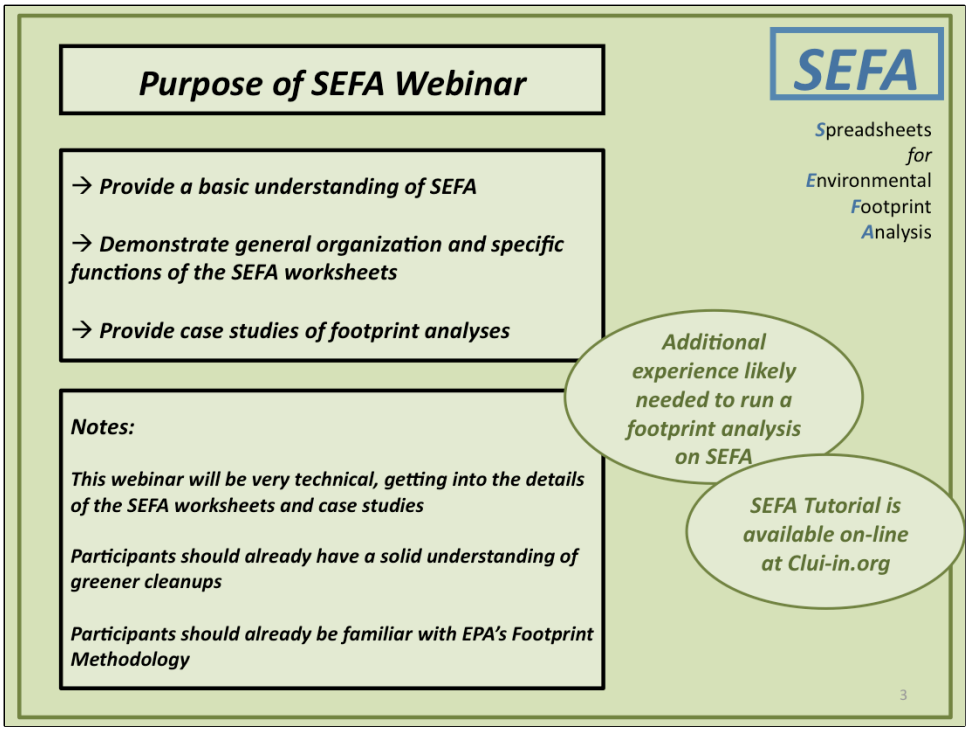
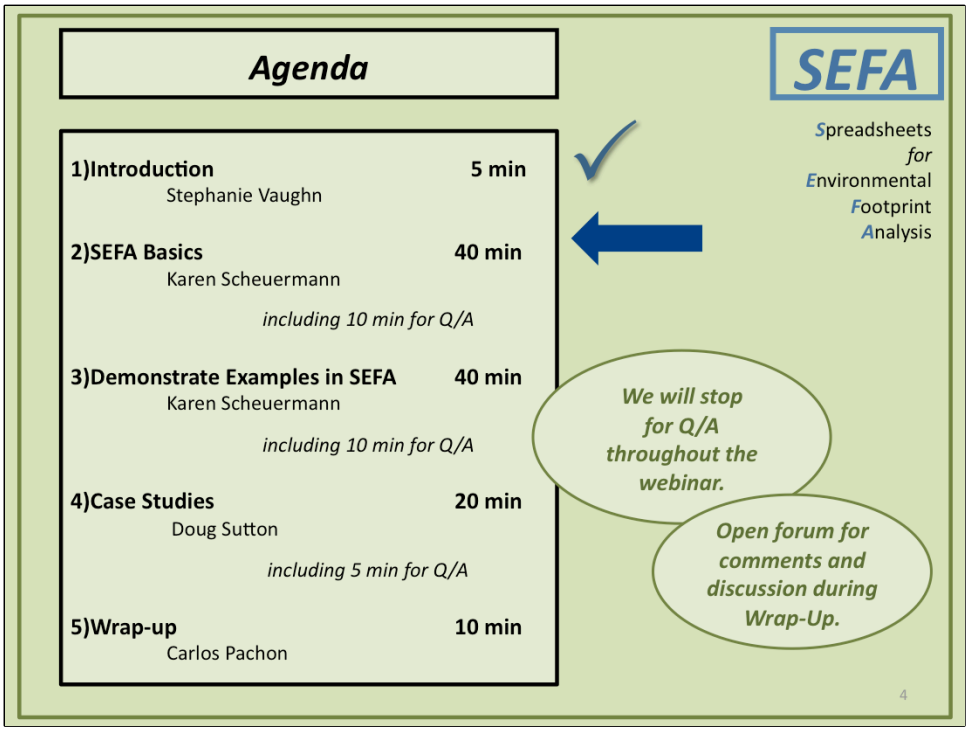

Purpose of SEFA Webinar
SEFA
Spreadsheets
for
Environmental
Footprint
Analysis
→ This is an introduction to SEFA
→ Methodology published in February 2012 by EPA
→ Find the Footprint Methodology and SEFA at
http://clu-in.org/greenremediation/methodology/index.cfm
→ Green Remediation: The practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions
→ Goal of Footprint Analysis: Identify the most significant contributors to a project's environmental footprint and better focus efforts to reduce it
SEFA is a companion tool to the footprint methodology
EPA's May 2013 webinar discussed the methodology in greater detail
2


Purpose of SEFA Webinar
SEFA
Spreadsheets
for
Environmental
Footprint
Analysis
→ Provide a basic understanding of SEFA
→ Demonstrate general organization and specific functions of the SEFA worksheets
→ Provide case studies of footprint analyses
Notes:
This webinar will be very technical, getting into the details of the SEFA worksheets and case studies
Participants should already have a solid understanding of greener cleanups
Participants should already be familiar with EPA's Footprint Methodology
Additional experience likely needed to run a footprint analysis on SEFA
SEFA Tutorial is available on-line at Clui-in.org
3


Agenda
SEFA
Spreadsheets for Environmental Footprint Analysis
1)Introduction 5 min
Stephanie Vaughn
2)SEFA Basics 40 min
Karen Scheuermann
including 10 min for Q/A
3)Demonstrate Examples in SEFA 40 min
Karen Scheuermann
including 10 min for Q/A
4)Case Studies 20 min
Doug Sutton
including 5 min for Q/A
5)Wrap-up 10 min
Carlos Pachon
We will stop for Q/A throughout the webinar.
Open forum for comments and discussion during Wrap-Up.
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SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

SEFA Basics

Will show the basic organization of SEFA using a tutorial-style footprint analysis at a hypothetical site

- → ***Graphics to explain organization of SEFA***
- → ***Followed by screenshots showing features of the data entry sheets***
- → ***Specifics of data entry will be demonstrated in the following section***

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Description of SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

SEFA is…

→ **a set of Excel workbooks developed by EPA**

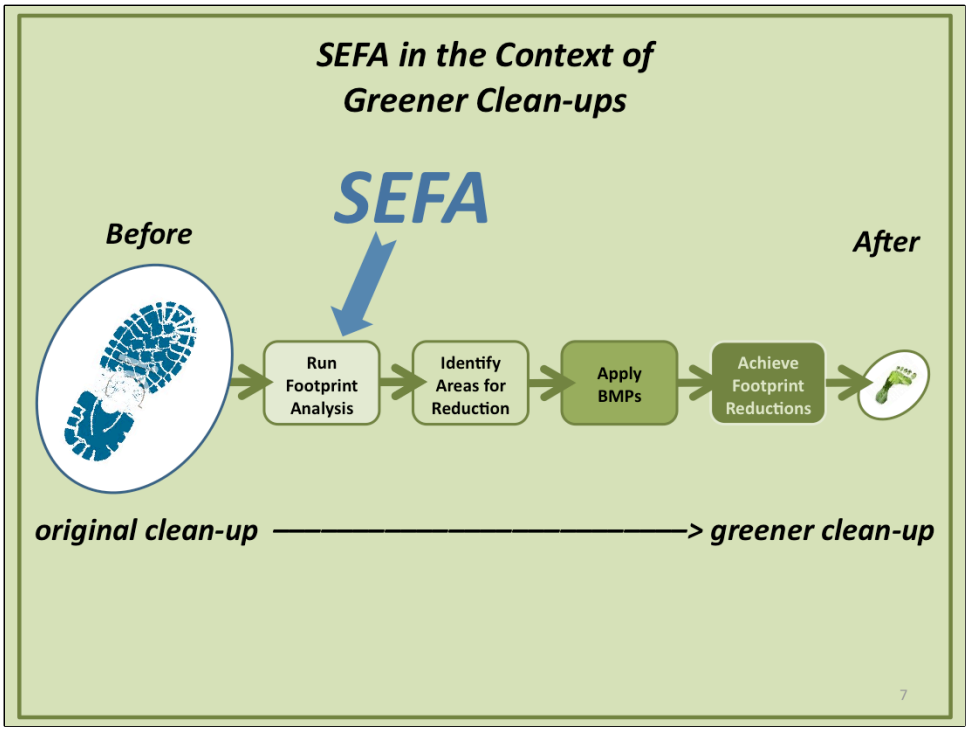
→ **designed for conducting environmental footprint analyses at clean-up sites**

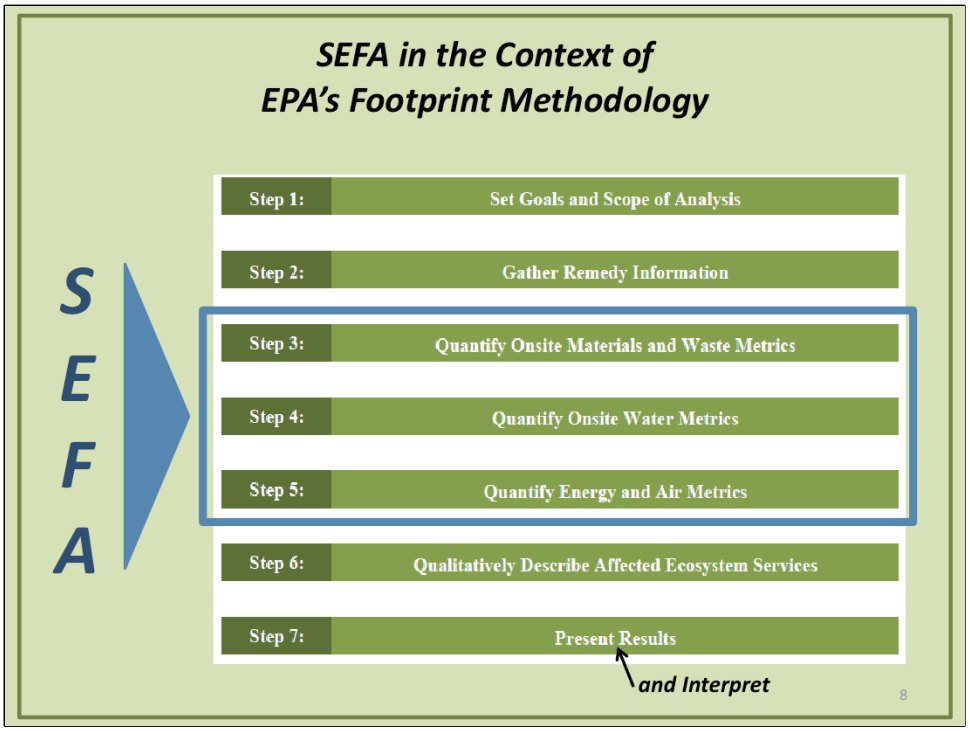
→ **compatible with EPA's Footprint Methodology**

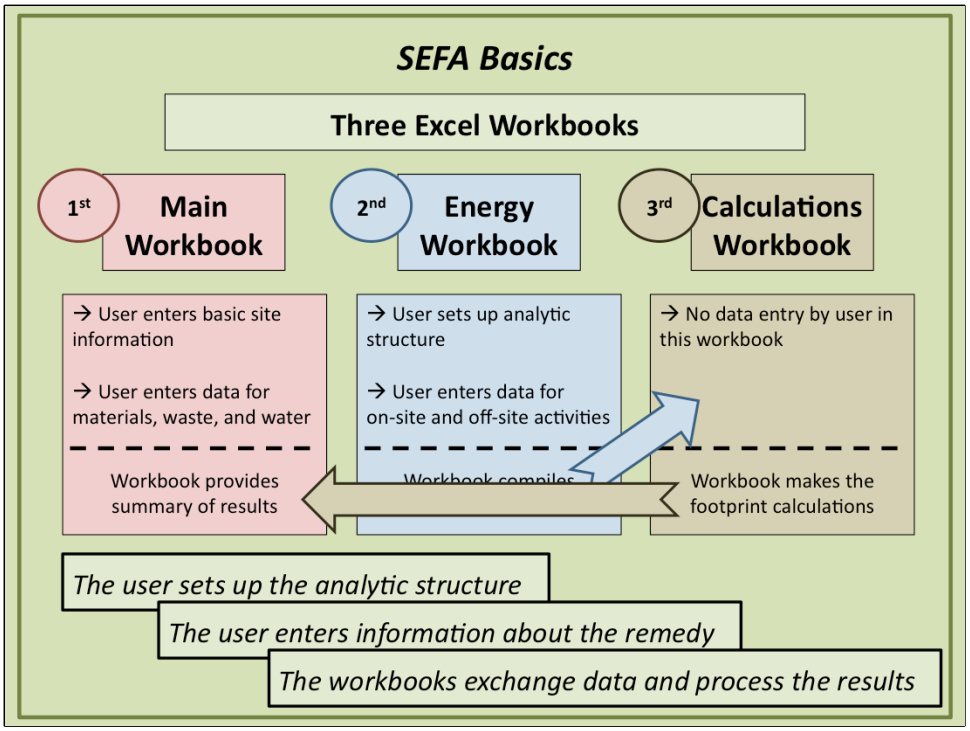
→ **set up in "blank slate" template format**

→ **structured for inputting data, running calculations, and organizing outputs**

SEFA and EPA's Footprint Methodology are posted at: www.cluin.org/greenremediation/methodology/index.cfm

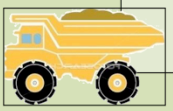

SEFA in the Context of Greener Clean-ups
SEFA
Before
After
Run Footprint Analysis
Identify Areas for Reduction
Apply BMPs
Achieve Footprint Reductions
original clean-up
> greener clean-up
7


SEFA in the Context of
EPA's Footprint Methodology
S
E
F
A
Step 1: Set Goals and Scope of Analysis
Step 2: Gather Remedy Information
Step 3: Quantify Onsite Materials and Waste Metrics
Step 4: Quantify Onsite Water Metrics
Step 5: Quantify Energy and Air Metrics
Step 6: Qualitatively Describe Affected Ecosystem Services
Step 7: Present Results
and Interpret
8


SEFA Basics
Three Excel Workbooks
1st
Main Workbook
2nd
Energy Workbook
3rd
Calculations Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
→ User sets up analytic structure
→ User enters data for on-site and off-site activities
→ No data entry by user in this workbook
Workbook provides summary of results
Workbook makes the footprint calculations
The user sets up the analytic structure
The user enters information about the remedy
The workbooks exchange data and process the results

Hypothetical Site

Simple Dig&Haul Remedy



Remediation at "Back Forty" Site

- conduct site investigation
- excavate contaminated soil
- transport soil to off-site landfill
- backfill excavated areas
- conduct groundwater monitoring

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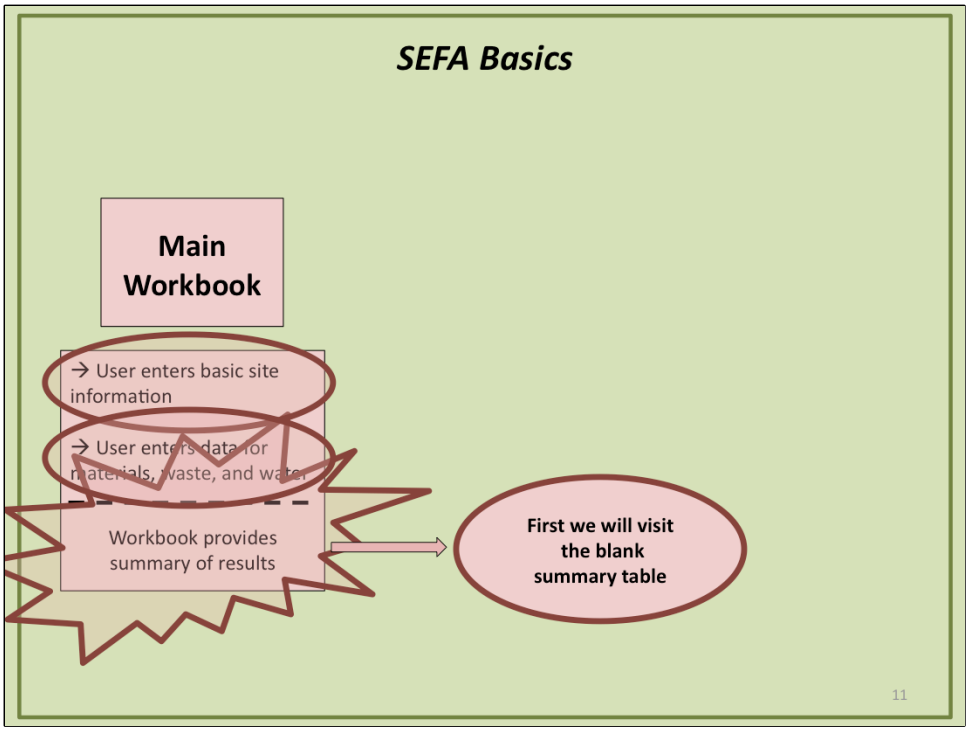
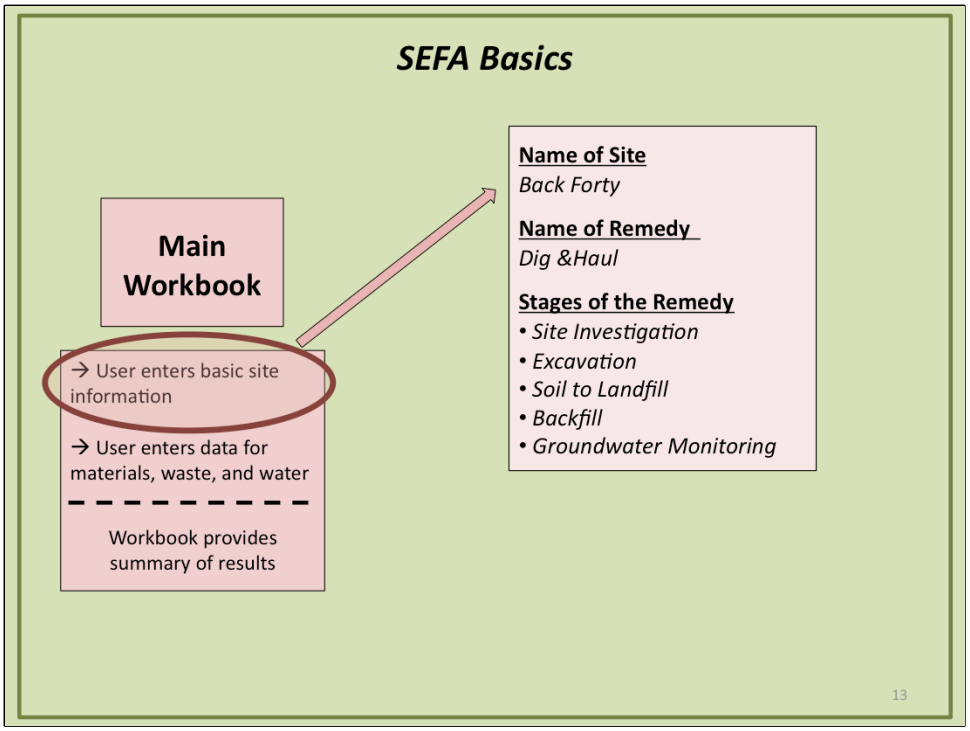

SEFA Basics
Main Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
Workbook provides summary of results
First we will visit the blank summary table
11

Summary Table – Blank before Data Entry

Core Element	Metric	Unit of Measure	Footprint					Total
			Component	Component 2	Component 3	Component 4	Component 5	
Materials & Waste	Refined materials used on-site							-
	% of refined materials from recycled or waste m	%						
	Unrefined materials used on-site		0	0	0	0	0	-
	On-site hazardous waste disposed of		0	0	0	0		-
			0	0	0		0	-
	% of total non-hazardous waste recycled or re	%						
Water	On-site water used		0	0	0	0	0	-
Energy	Total energy use							-
	Total energy directly derived from renewable resources							
	- Biodiesel use and on-site generation				0	0	0	-
	- Voluntary purchase of renewable electricity		0	0	0	0	0	-
	- Voluntary purchase of RECs		0	0	0	0	0	-
Air	On-site NOx, SOx, and PM emissions		0	0	0	0	0	-
	On-site HAP emissions		0	0	0	0	0	-
	Total NOx, SOx, and PM emissions		0	0	0	0	0	-
	Total HAP emissions		0	0	0	0	0	-
	Total greenhouse gas emissions		0	0	0	0	0	-

THIS SUMMARY TABLE IS SET UP TO REFLECT EPA'S FOOTPRINT METHODOLOGY

WE WILL REVISIT THIS TABLE AFTER EACH STAGE OF DATA ENTRY


SEFA Basics
Main Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
Workbook provides summary of results
Name of Site
Back Forty
Name of Remedy
Dig &Haul
Stages of the Remedy
• Site Investigation
• Excavation
• Soil to Landfill
• Backfill
• Groundwater Monitoring
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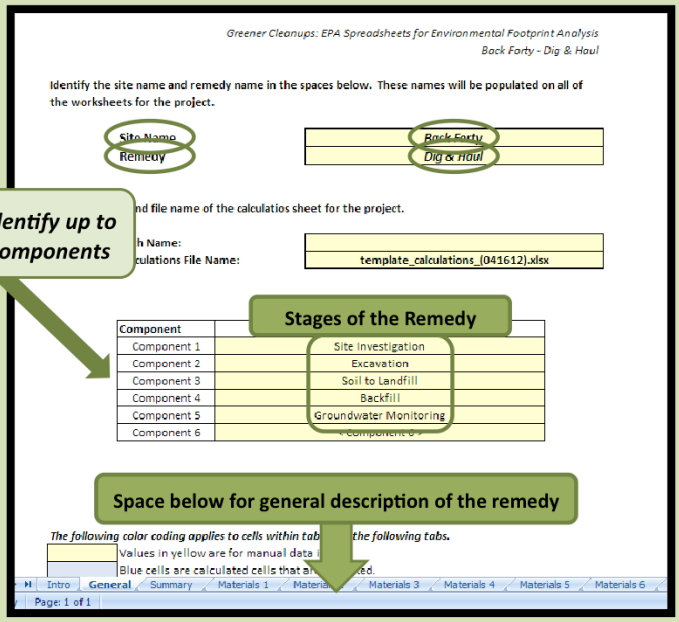
Enter Basic Site Information into Main Workbook

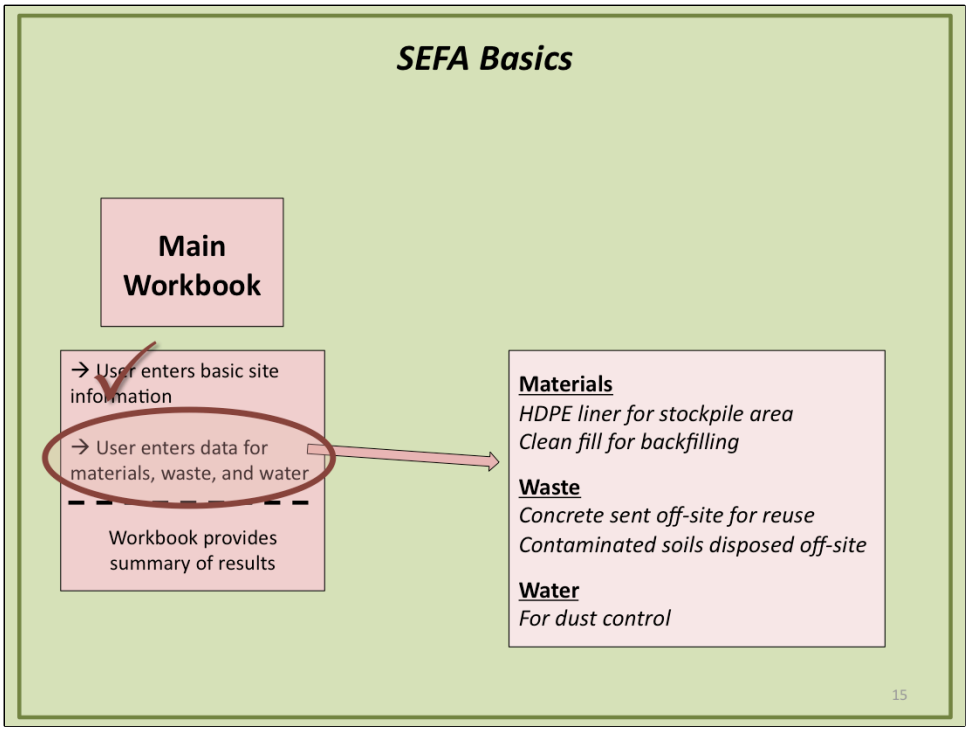


User may identify up to 6 remedy components

Stages of the Remedy

Space below for general description of the remedy

14


SEFA Basics
Main Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
Workbook provides summary of results
Materials
HDPE liner for stockpile area
Clean fill for backfilling
Waste
Concrete sent off-site for reuse
Contaminated soils disposed off-site
Water
For dust control
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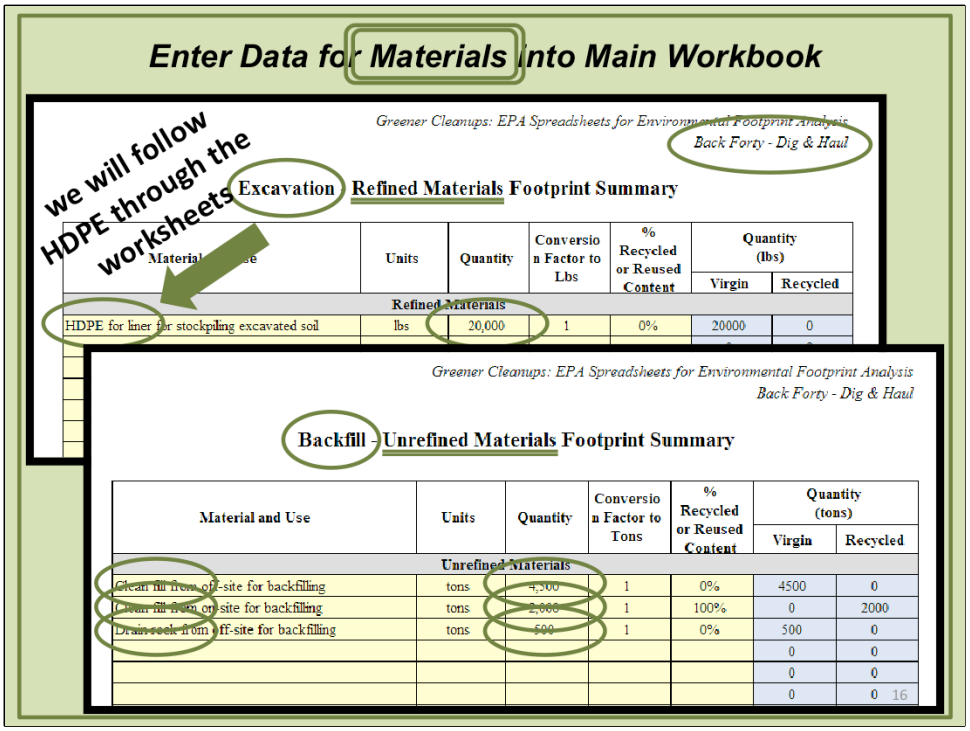
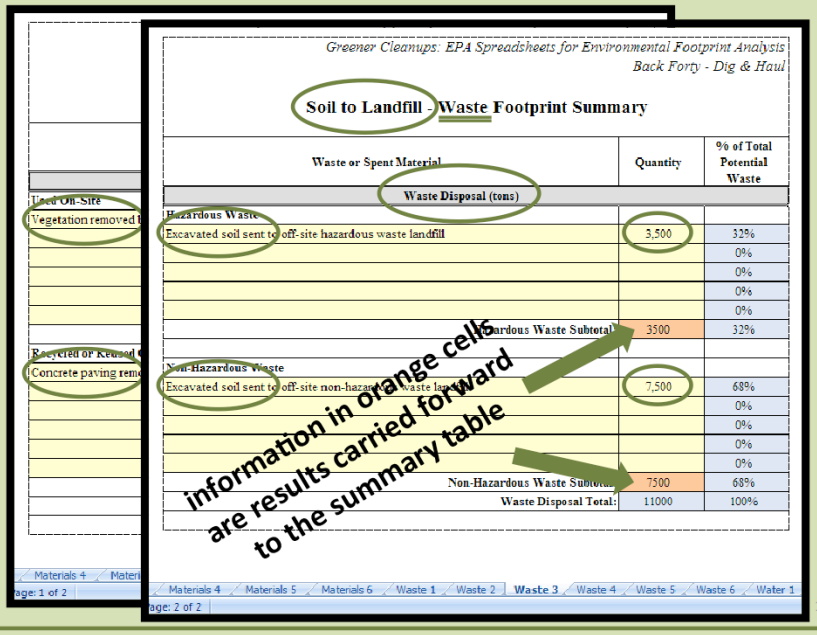
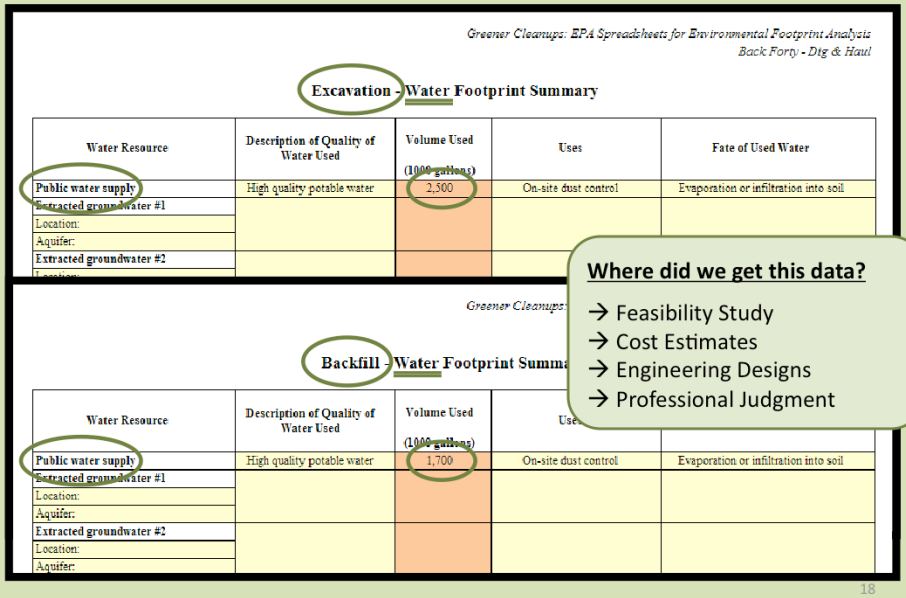

Enter Data for Materials into Main Workbook
we will follow HDPE through the worksheets
Greener Cleanups: EPA Spreadsheets for Environmental Footprint Analysis
Back Forty - Dig & Haul
Excavation Refined Materials Footprint Summary
Material and Use
Units
Quantity
Conversion Factor to Lbs
% Recycled or Reused Content
Quantity (lbs)
Virgin
Recycled
Refined Materials
HDPE for liner for stockpiling excavated soil
lbs
20,000
1
0%
20000
0
Greener Cleanups: EPA Spreadsheets for Environmental Footprint Analysis
Back Forty - Dig & Haul
Backfill - Unrefined Materials Footprint Summary
Material and Use
Units
Quantity
Conversion Factor to Tons
% Recycled or Reused Content
Quantity (tons)
Virgin
Recycled
Unrefined Materials
Clean fill from off-site for backfilling
tons
4,500
1
0%
4500
0
Clean fill from on-site for backfilling
tons
2,000
1
100%
0
2000
Drain sock from off-site for backfilling
tons
500
1
0%
500
0
0
0
0
0
0
16

Enter Data for Waste into Main Workbook



Enter Data for Water into Main Workbook



Greener Cleanups: EPA Spreadsheets for Environmental Footprint Analysis
Back Forty - Dig & Haul

Excavation - Water Footprint Summary

Water Resource	Description of Quality of Water Used	Volume Used (1000 gallons)	Uses	Fate of Used Water
Public water supply	High quality potable water	2,500	On-site dust control	Evaporation or infiltration into soil
Extracted groundwater #1				
Location:				
Aquifer:				
Extracted groundwater #2				

Greener Cleanups:

Backfill - Water Footprint Summa

Water Resource	Description of Quality of Water Used	Volume Used (1000 gallons)	Use	
Public water supply	High quality potable water	1,700	On-site dust control	Evaporation or infiltration into soil
Extracted groundwater #1				
Location:				
Aquifer:				
Extracted groundwater #2				
Location:				
Aquifer:				

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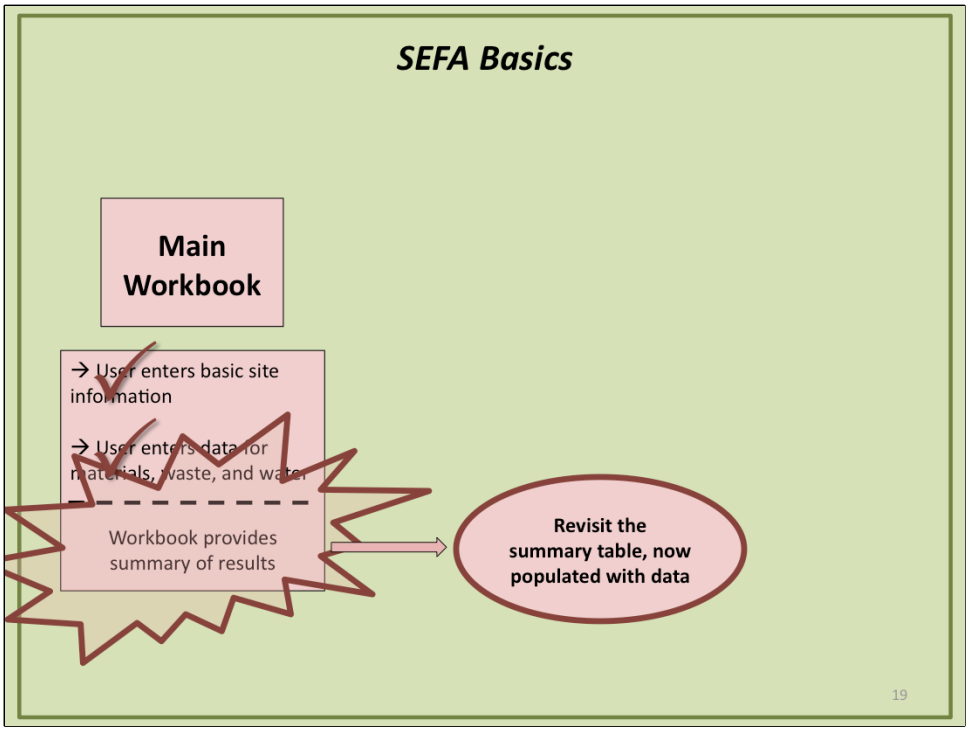
Where did we get this data?

→ Feasibility Study
→ Cost Estimates
→ Engineering Designs
→ Professional Judgment


SEFA Basics
Main Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
Workbook provides summary of results
Revisit the summary table, now populated with data
19

Summary Table – Showing Materials Data

Core Element	Metric	Unit of Measure	Footprint					TOTALS
			Site Investigation	Excavation	Soil to Landfill	Backfill	Groundwater Monitoring	
Materials & Waste	Refined materials used on-site	Tons	0	10	0	0	0	10
	% of refined materials from recycled or waste material	%		0%				0%
	Unrefined materials used on-site	Tons	0	1500	0	7000	0	8,500
	% of unrefined materials from recycled or waste material	%		0%		29%		24%
	On-site hazardous waste disposed of off-site	Tons		0	0	0	0	-
	On-site non-hazardous waste disposed		0	0	0	0	0	-
	% of total potential waste recycled or							
Water	On-site public water use (by source)		0	0				-
Energy	Total energy used	MMBtu	0	0				-
	Total energy voluntarily derived from renewable resources							
	- Biodiesel use and onsite generation or use	MMBtu	0	0	0	0	0	-
	- Voluntary purchase of renewable electricity	MWh	0	0	0	0	0	-
	- Voluntary purchase of RECs	MWh	0	0	0	0	0	-
Air	On-site NOx, SOx, and PM emissions	Pounds	0	0	0	0	0	-
	On-site HAP emissions	Pounds	0	0	0	0	0	-
	Total NOx, SOx, and PM emissions	Pounds	0	0	0	0	0	-
	Total HAP emissions	Pounds	0	0	0	0	0	-
	Total greenhouse gas emissions	Tons CO2e	0	0	0	0	0	-

Materials

tons

amount of materials

% of materials from recycled sources

Summary Table – Showing Waste Data

Core Element	Metric	U M	Footprint					
					Soil to Landfill	Backfill	Groundwater Monitoring	Total
Materials & Waste	Refined materials used on-site				0	0	0	10
	% of refined materials from recycled or waste material	%		0%				
	Unrefined materials used on-site	Tons	0	1500	0	7000	0	
		%		0%		29%		
	On-site hazardous waste disposed of off-site		10	0	3500	0	0	3,510
	On-site non-hazardous waste disposed of off-site		0	500	7500	0	0	8,000
	% of total potential waste recycled or reused	%	0%	80%	0%			15%
Water	On-site public water use (by source)	MG	0	0	0	0	0	-
Energy	Total energy used	MMBtu	0	0	0	0	0	-
	Total energy voluntarily derived from renewable resources							
	- Biodiesel use and onsite generation or use	MMBtu	0	0	0	0	0	-
	- Voluntary purchase of renewable electricity	MWh	0	0	0	0	0	-
	- Voluntary purchase of RECs	MWh	0	0	0	0	0	-
Air	On-site NOx, SOx, and PM emissions	Pounds	0	0	0	0	0	-
	On-site HAP emissions	Pounds	0	0	0	0	0	-
	Total NOx, SOx, and PM emissions	Pounds	0	0	0	0	0	-
	Total HAP emissions	Pounds	0	0	0	0	0	-
	Total greenhouse gas emissions	Tons CO2e	0	0	0	0	0	-

amount of waste

TOTALS

Waste

tons

% of waste to reuse or recycling

Summary Table – Showing Water Data

Core Element	Metric	Unit of Measure	Footprint					
			Site Investigation	Excavation	Soil to Landfill	Backfill	Groundwater Monitoring	Total
Materials & Waste	Refined materials used on-site	Tons	0	10	0	0	0	10
	% of refined materials from recycled or waste material	%		0%				0%
	Unrefined materials used on-site	Tons	0	1500	0	7000	0	8,500
	% of unrefined materials from recycled or waste material	%		[illegible]		29%		24%
	On-site hazardous waste disposed of off-site	[illegible]	[illegible]	0	3500	0	0	[illegible]
	[illegible]	Tons	0	[illegible]	[illegible]	0	0	[illegible]
	% of total potential waste recycled or reused	[illegible]	[illegible]	[illegible]	0%			[illegible]
Water	On-site public water use (b[illegible]	[illegible]	0	3	[illegible]	2	0	4
Energy	Total energy used	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Total energy voluntarily derived from [illegible]							
	- Biodiesel use and onsite generation or use	MMBtu	0	0	0	0	0	-
	- Voluntary purchase of renewable electricity	MWh	[illegible]	[illegible]	0	0	0	-
	- Voluntary purchase of RECs	MWh	[illegible]	[illegible]	[illegible]	0	0	-
Air	On-site NOx, SOx, and PM emissions	Pounds	[illegible]	[illegible]	[illegible]	0	0	-
	On-site HAP emissions	Pounds	[illegible]	[illegible]	[illegible]	0	0	-
	Total NOx, SOx, and PM emissions	Pounds	0	0	0	0	0	-
	Total HAP emissions	Pounds	0	0	0	0	0	-
	Total greenhouse gas emissions	Tons CO2e	0	0	0	0	0	-

TOTAL

amount of water

WE HAVE NOW COMPLETED THE FIRST PART OF OUR FOOTPRINT METRICS

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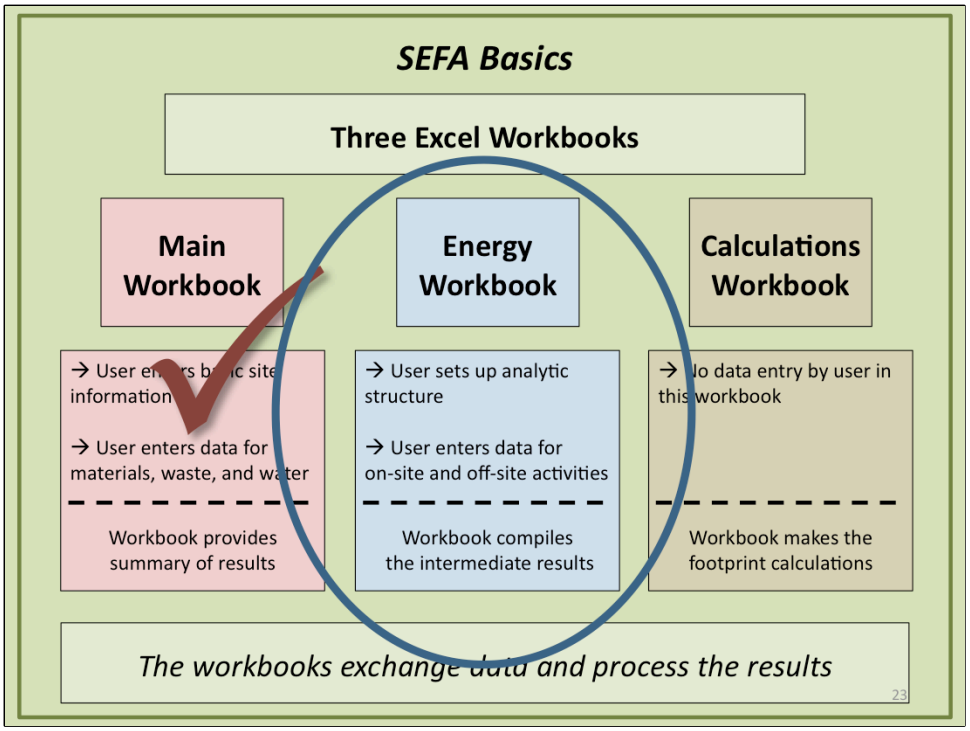
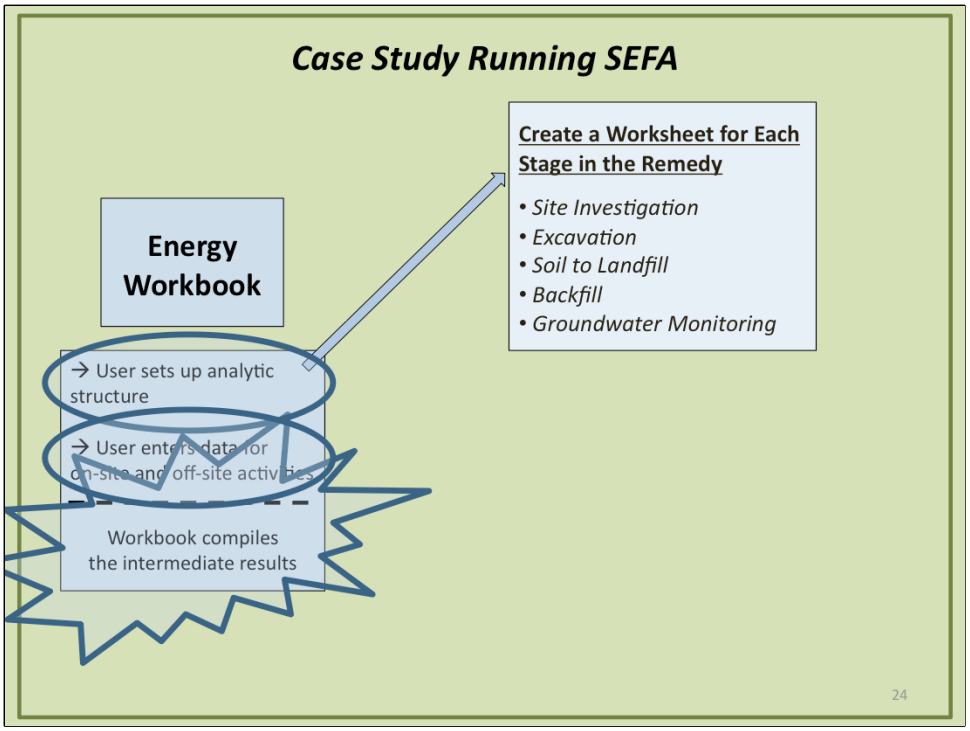
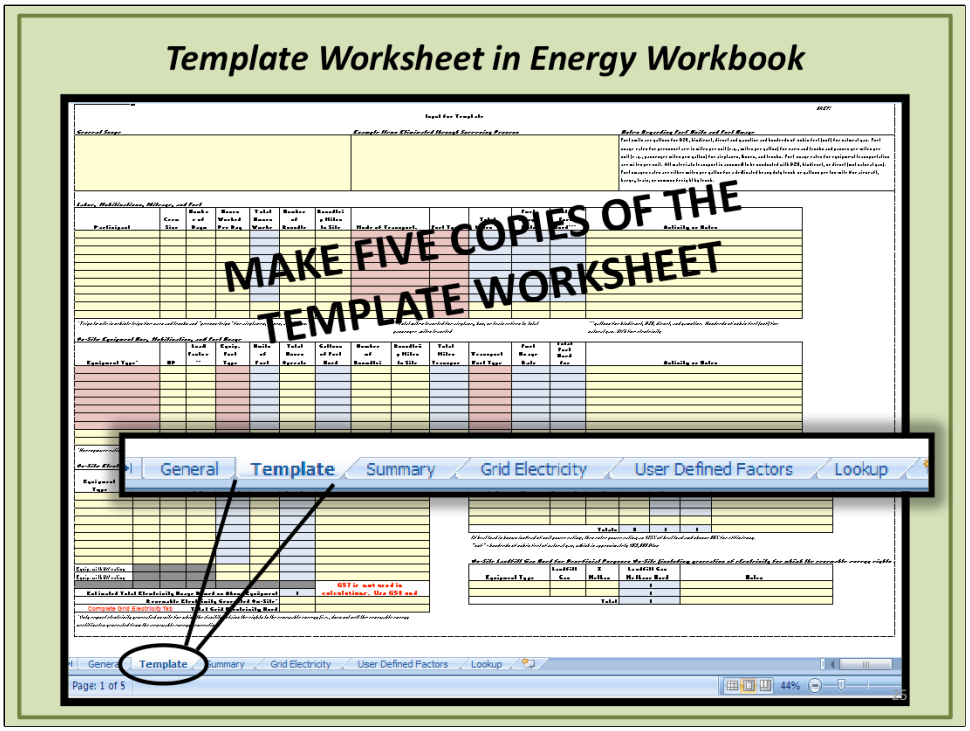
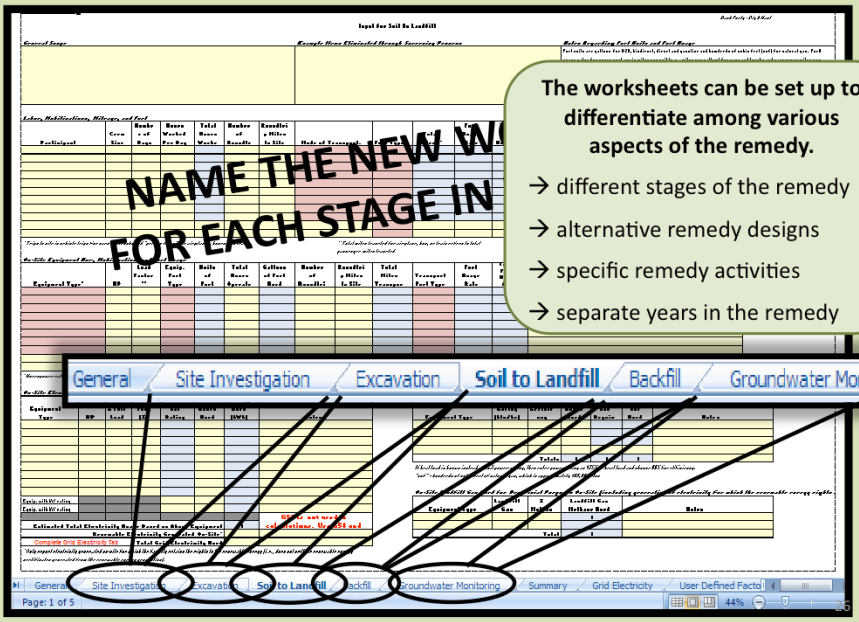

SEFA Basics
Three Excel Workbooks
Main Workbook
Energy Workbook
Calculations Workbook
→ User enters basic site information
→ User enters data for materials, waste, and water
Workbook provides summary of results
→ User sets up analytic structure
→ User enters data for on-site and off-site activities
Workbook compiles the intermediate results
→ No data entry by user in this workbook
Workbook makes the footprint calculations
The workbooks exchange data and process the results
23


Case Study Running SEFA
Energy Workbook
Create a Worksheet for Each Stage in the Remedy
• Site Investigation
• Excavation
• Soil to Landfill
• Backfill
• Groundwater Monitoring
→ User sets up analytic structure
→ User enters data for on-site and off-site activities
Workbook compiles the intermediate results
24

Template Worksheet in Energy Workbook



Template Worksheet in Energy Workbook



The worksheets can be set up to differentiate among various aspects of the remedy.

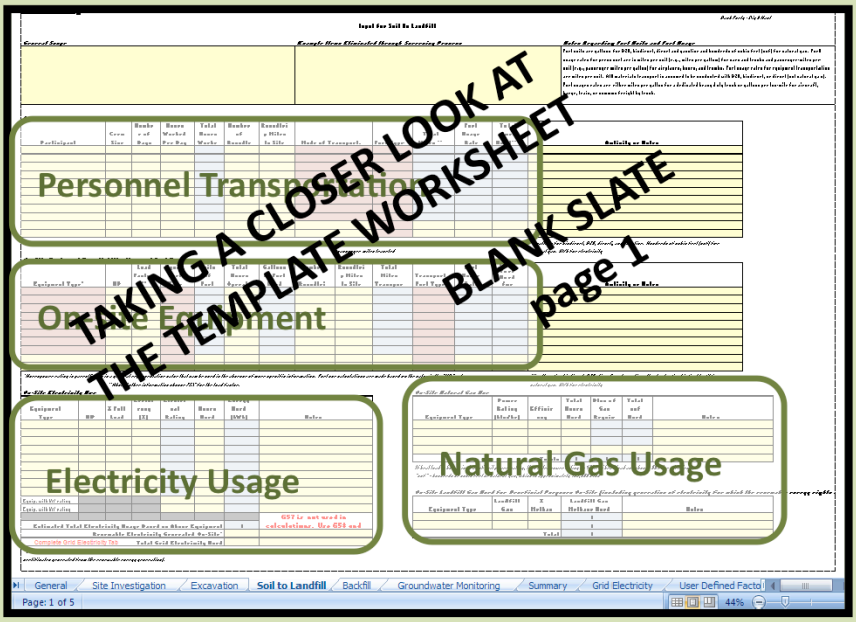
→ different stages of the remedy

→ alternative remedy designs

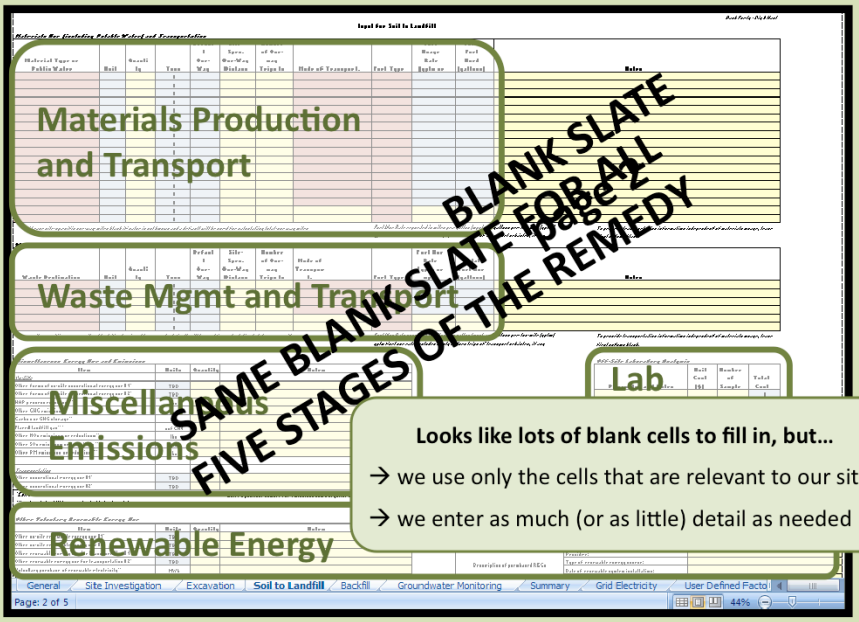
→ specific remedy activities

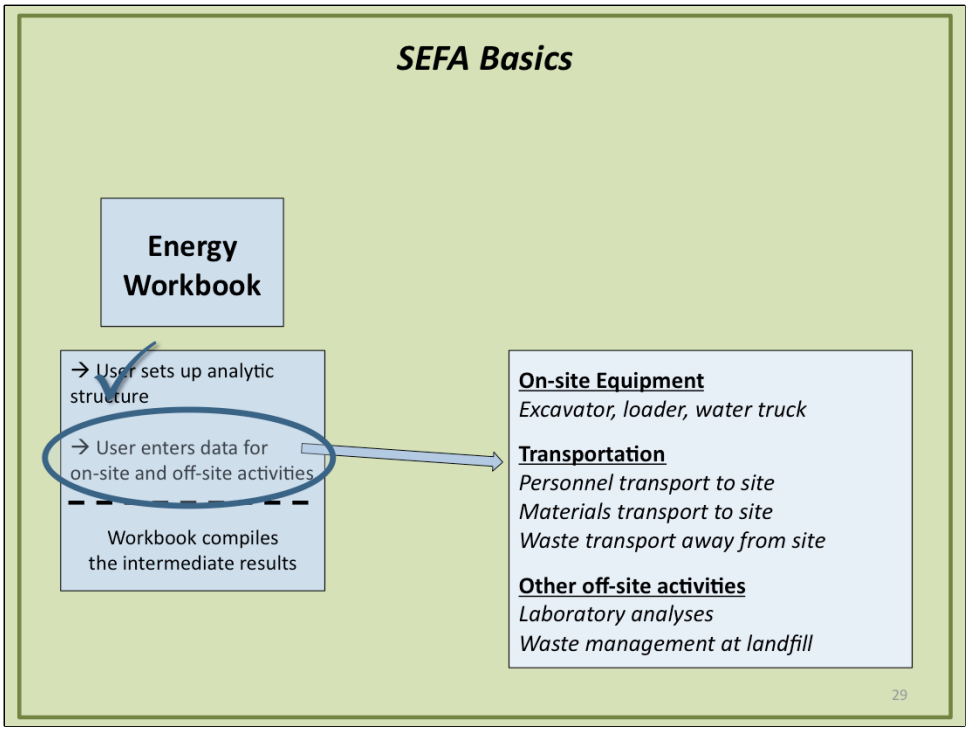
→ separate years in the remedy

Template Worksheet in Energy Workbook



Template Worksheet in Energy Workbook




SEFA Basics
Energy Workbook
→ User sets up analytic structure
→ User enters data for on-site and off-site activities
Workbook compiles the intermediate results
On-site Equipment
Excavator, loader, water truck
Transportation
Personnel transport to site
Materials transport to site
Waste transport away from site
Other off-site activities
Laboratory analyses
Waste management at landfill
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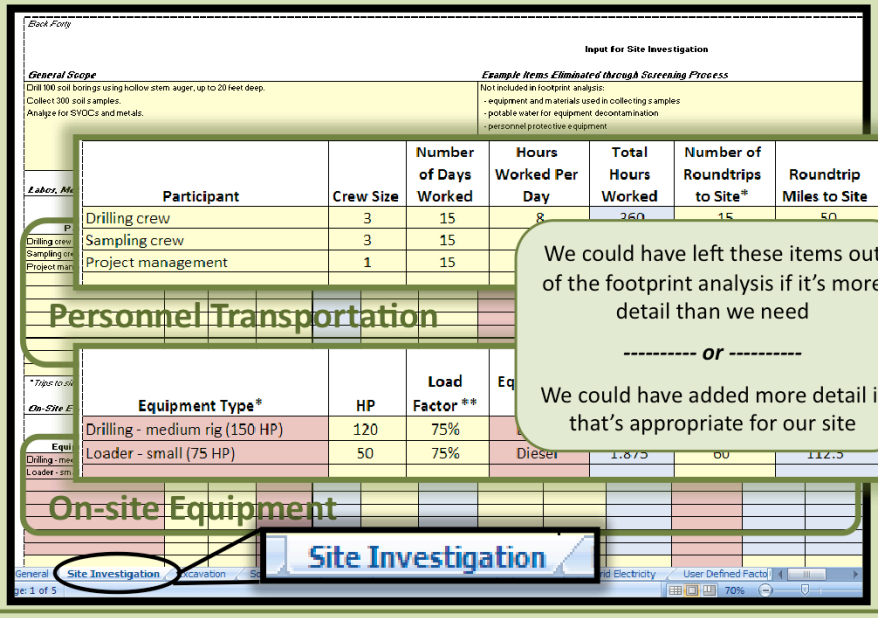
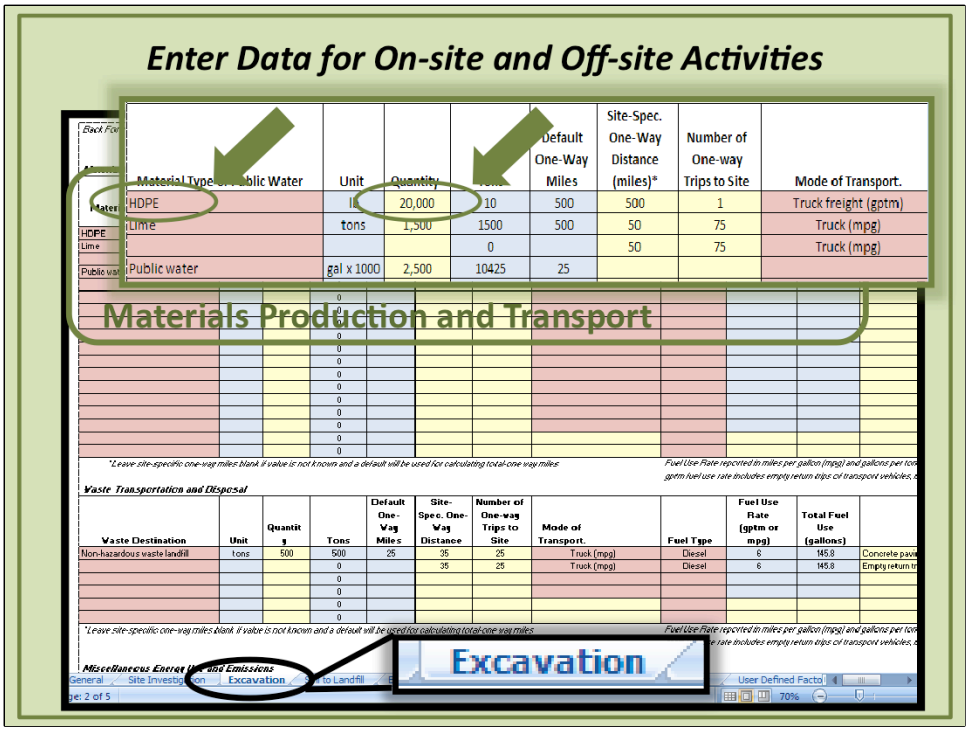
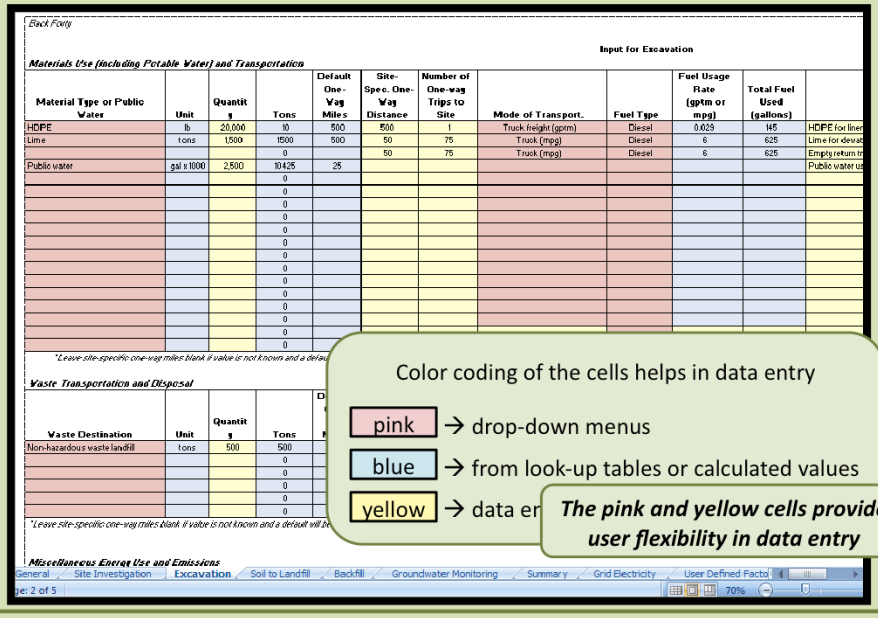
Enter Data for On-site and Off-site Activities



Enter Data for On-site and Off-site Activities



Enter Data for On-site and Off-site Activities



Back Forty

Input for Excavation

Materials Use (including Potable Water) and Transportation

Material Type or Public Water	Unit	Quantity	Tons	Default One-Way Miles	Site-Spec. One-Way Distance	Number of One-way Trips to Site	Mode of Transport.	Fuel Type	Fuel Usage Rate (gptm or mpg)	Total Fuel Used (gallons)	
HDPE	lb	20,000	10	500	500	1	Truck freight (gptm)	Diesel	0.029	145	HDPE for liner
Lime	tons	1,500	1500	500	50	75	Truck (mpg)	Diesel	6	625	Lime for dewat
			0		50	75	Truck (mpg)	Diesel	6	625	Empty return tr
Public water	gal x 1000	2,500	10425	25							Public water us
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								
			0								

*Leave site-specific one-way miles blank if value is not known and a defau

Waste Transportation and Disposal

Waste Destination	Unit	Quantity	Tons	D
Non-hazardous waste landfill	tons	500	500	
			0	
			0	
			0	
			0	
			0	

*Leave site-specific one-way miles blank. If value is not known and a default will b

Miscellaneous Energy Use and Emissions

General | Site Investigation | Excavation | Soil to Landfill | Backfill | Groundwater Monitoring | Summary | Grid Electricity | User Defined Factor

Page: 2 of 5 70%

Color coding of the cells helps in data entry

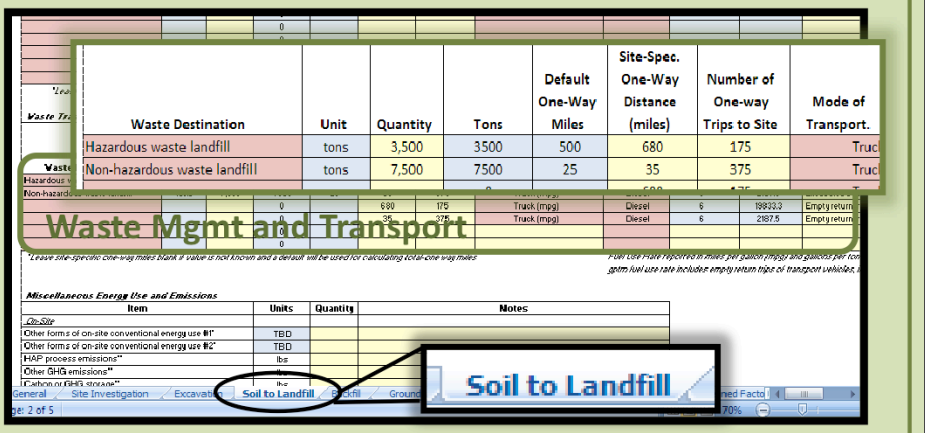
pink → drop-down menus

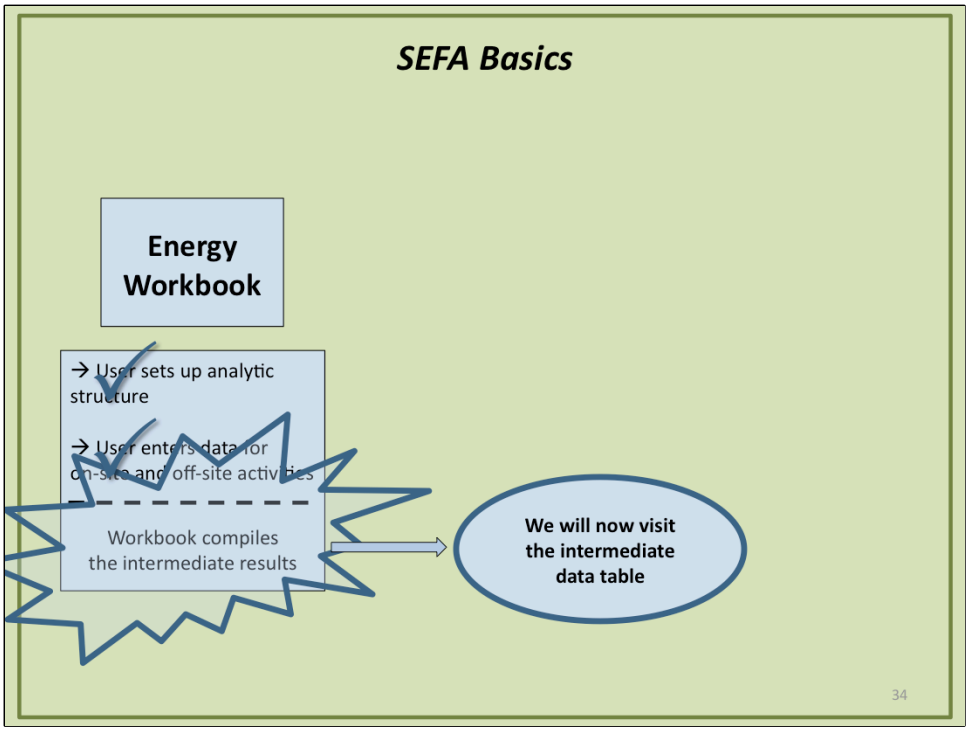
blue → from look-up tables or calculated values

yellow → data en

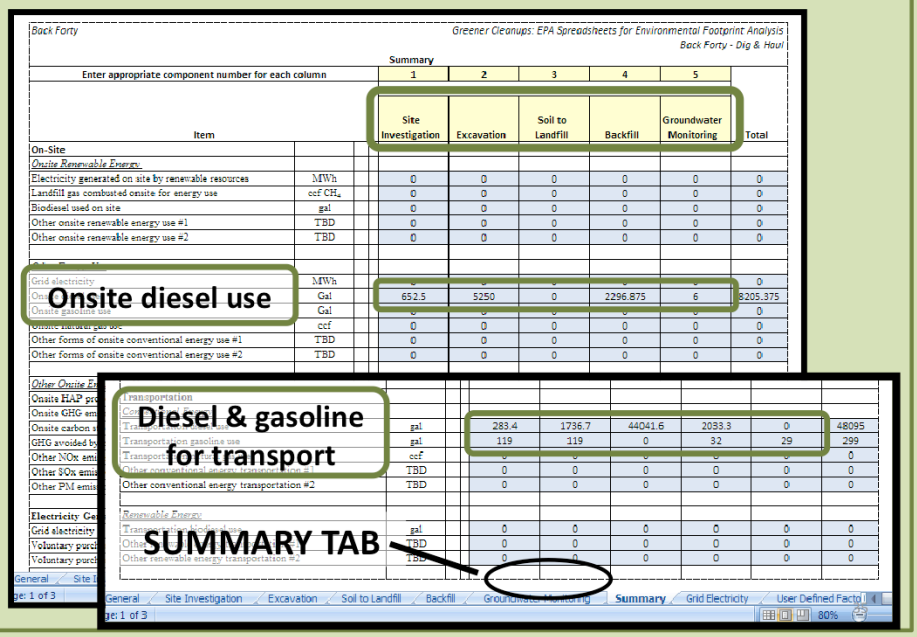
The pink and yellow cells provide user flexibility in data entry

Enter Data for On-site and Off-site Activities

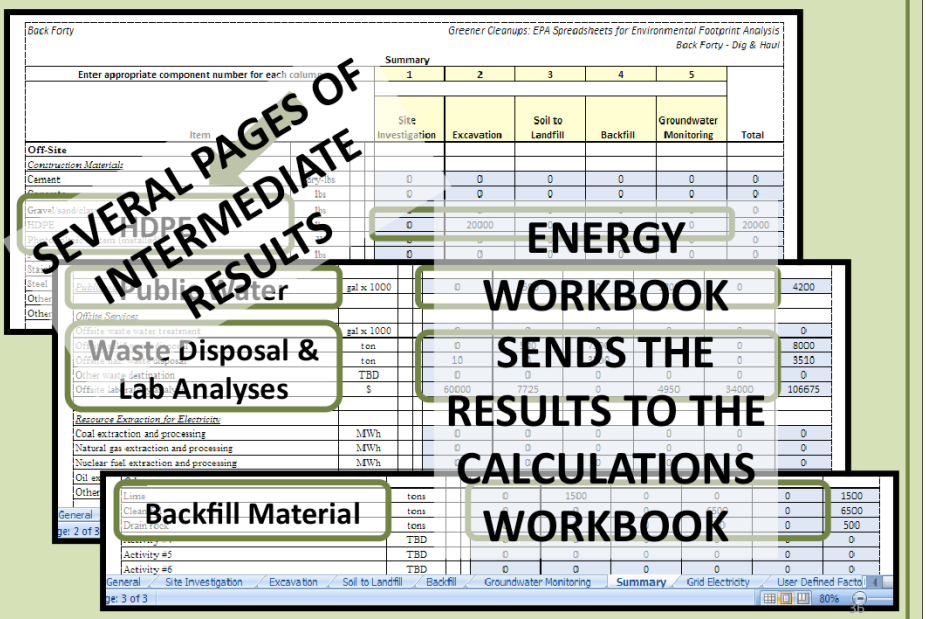


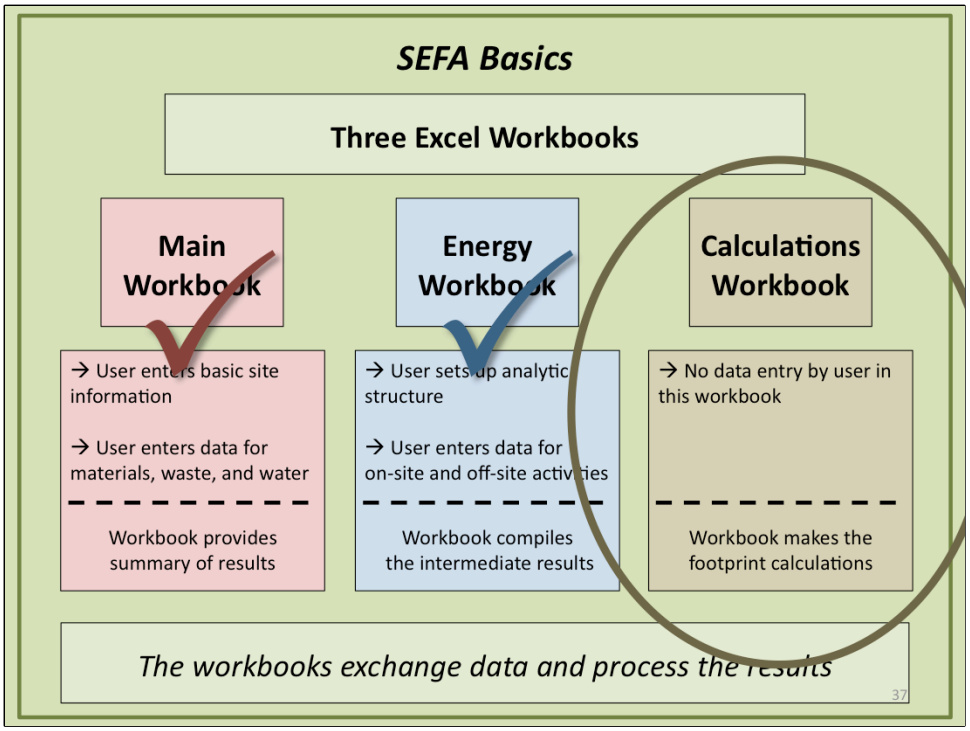

SEFA Basics
Energy Workbook
→ User sets up analytic structure
→ User enters data for on-site and off-site activities
Workbook compiles the intermediate results
We will now visit the intermediate data table
34

Intermediate Data Table – Energy Workbook



Intermediate Data Table – Energy Workbook




SEFA Basics
Three Excel Workbooks
Main Workbook
Energy Workbook
Calculations Workbook
→ User enters basic site information
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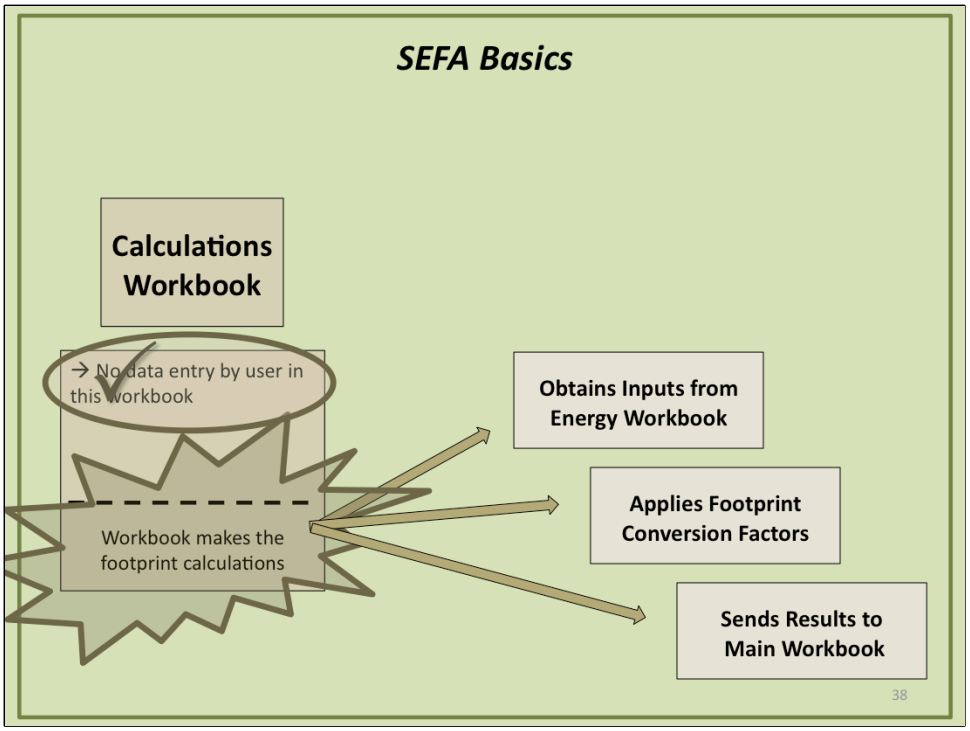
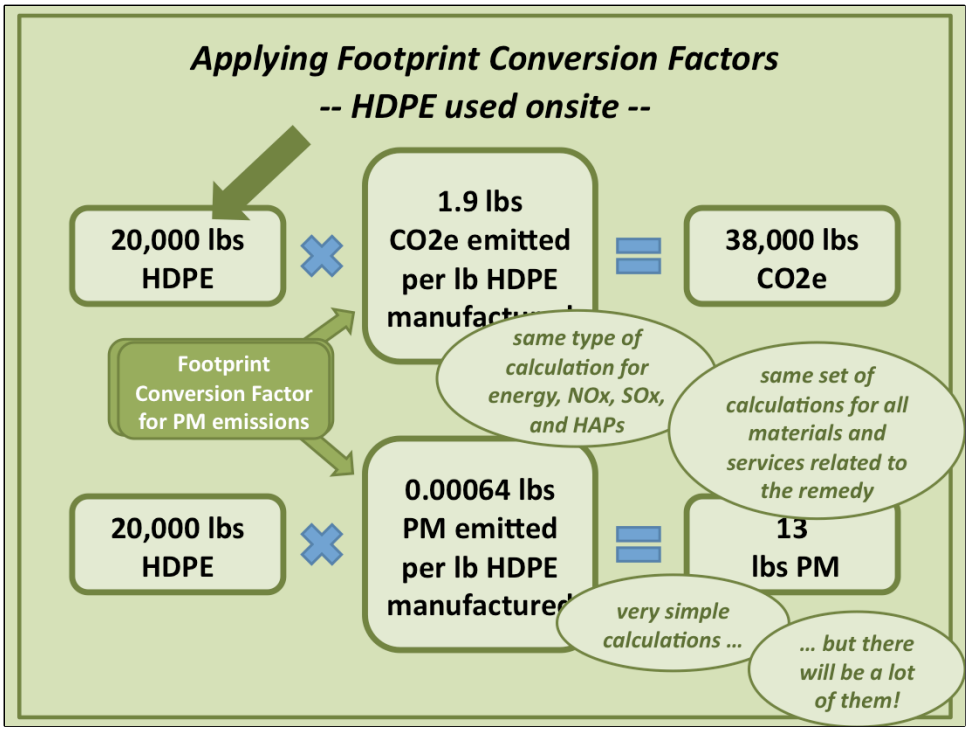
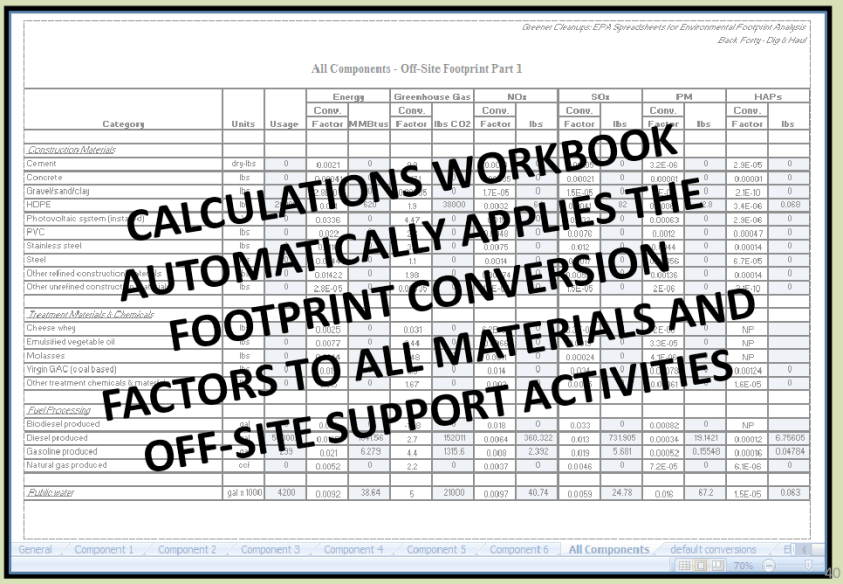
Workbook compiles the intermediate results
→ No data entry by user in this workbook
Workbook makes the footprint calculations
The workbooks exchange data and process the results
37


SEFA Basics
Calculations Workbook
→ No data entry by user in this workbook
Workbook makes the footprint calculations
Obtains Inputs from Energy Workbook
Applies Footprint Conversion Factors
Sends Results to Main Workbook
38


Applying Footprint Conversion Factors
-- HDPE used onsite --
20,000 lbs HDPE
1.9 lbs CO2e emitted per lb HDPE manufactu
38,000 lbs CO2e
Footprint Conversion Factor for PM emissions
same type of calculation for energy, NOx, SOx, and HAPs
same set of calculations for all materials and services related to the remedy
20,000 lbs HDPE
0.00064 lbs PM emitted per lb HDPE manufacture
13 lbs PM
very simple calculations ...
... but there will be a lot of them!

Applying Footprint Conversion Factors in the Calculations Workbook



Greener Cleanups: EPA Spreadsheets for Environmental Footprint Analysis
Back Forty - Dig & Haul

All Components - Off-Site Footprint Part 1

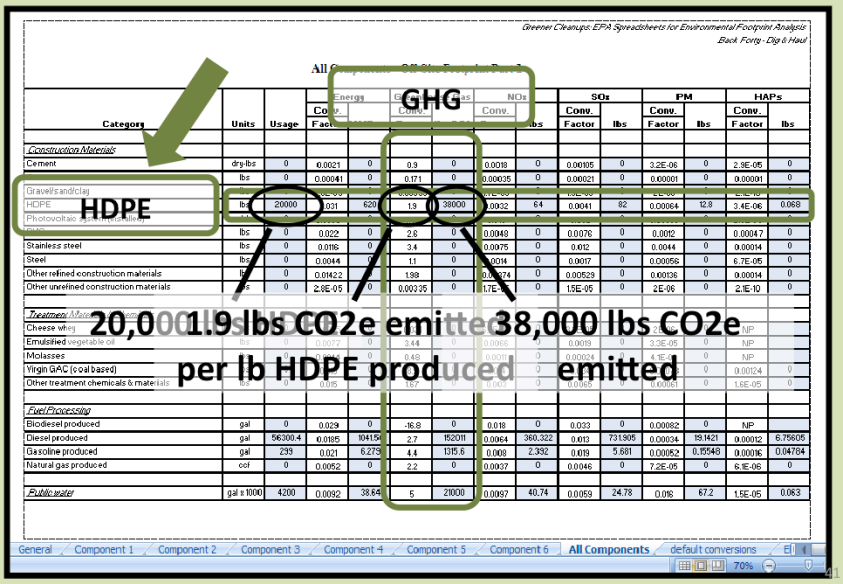
Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials:														
Cement	dry-lbs	0	0.0021	0	[illegible]		[illegible]		[illegible]		3.2E-06	0	2.3E-05	0
Concrete	lbs	0	[illegible]		[illegible]		[illegible]		0.00021	0	0.00001	0	0.00001	0
Gravel/sand/clay	lb	0	[illegible]		[illegible]	0	1.7E-05	0	1.5E-06	0	[illegible]		2.1E-10	0
HDPE	lbs	0	0.0	62.0	1.9	38000	0.0032	0	0.0	0	[illegible]	0	3.4E-06	0.068
Photovoltaic system (installed)	lbs	0	0.0336	0	4.47	0	0.0048	0	0.0078	0	0.00063	0	2.9E-06	0
PVC	lbs	0	0.0	[illegible]	[illegible]	0	[illegible]	0	0.0078	0	0.0012	0	0.00047	0
Stainless steel	lbs	[illegible]	[illegible]	[illegible]	[illegible]	0	0.0075	0	0.012	0	[illegible]	0	0.00014	0
Steel	lbs	[illegible]	[illegible]	[illegible]	1.1	0	0.0014	0	[illegible]	[illegible]	[illegible]	0	6.7E-05	0
Other refined construction	lbs	[illegible]	0.01422	0	1.93	0	[illegible]	[illegible]	[illegible]	[illegible]	0.00136	0	0.00014	0
Other unrefined construc	lbs	0	8.8E-05	0	[illegible]	[illegible]	[illegible]	[illegible]	1.2E-05	0	2E-06	0	2E-10	0
Treatment Materials & Chemicals:														
Cheese whey	lbs	0	0.0025	0	0.031	0	[illegible]		[illegible]		[illegible]		NP	
Emulsified vegetable oil	lbs	0	0.0072	0	0.14	0	[illegible]		[illegible]		3.3E-05	0	NP	
Molasses	lbs	0	[illegible]	[illegible]	1.8	[illegible]	[illegible]	[illegible]	0.00024	0	[illegible]		NP	
Virgin GAC (coal based)	lbs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.014	0	0.024	[illegible]	[illegible]		0.00124	0
Other treatment chemicals & mater	lbs	0	[illegible]	0	1.67	0	[illegible]	[illegible]	0.013	[illegible]	[illegible]		1.6E-05	0
Fuel Processing														
Biodiesel produced	gal	[illegible]	0.0	[illegible]	[illegible]	[illegible]	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	[illegible]	0.0	[illegible]	2.7	152011	0.0064	360.322	0.013	731.905	0.00034	19.1421	0.00012	6.75605
Gasoline produced	gal	[illegible]	0.021	6.279	4.4	1315.6	0.008	2.392	0.019	5.681	0.00052	0.15548	0.00016	0.04784
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	7.2E-05	0	6.1E-06	0
Public water	gal x1000	4200	0.0092	38.64	5	21000	0.0097	40.74	0.0059	24.78	0.016	67.2	1.5E-05	0.063

General | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 | Component 6 | All Components | default conversions | EI

70%

CALCULATIONS WORKBOOK AUTOMATICALLY APPLIES THE FOOTPRINT CONVERSION FACTORS TO ALL MATERIALS AND OFF-SITE SUPPORT ACTIVITIES

Applying Footprint Conversion Factors in the Calculations Workbook



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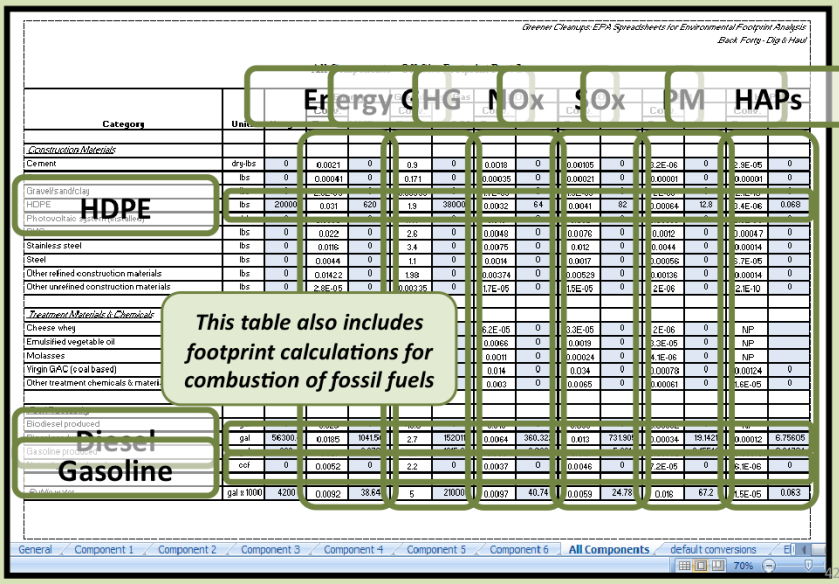
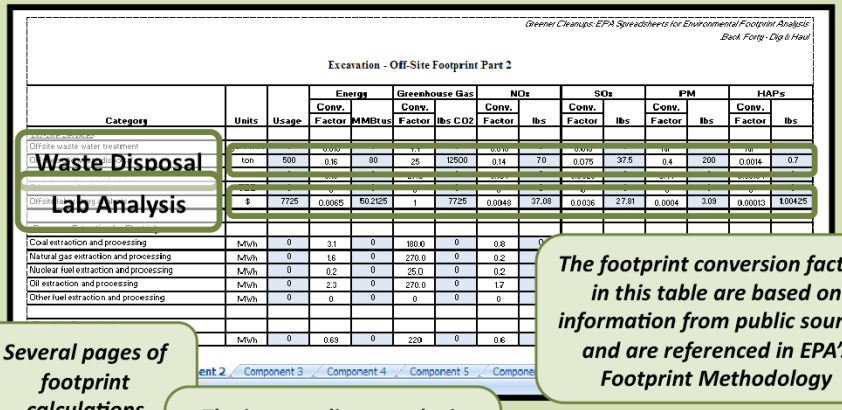


Applying Footprint Conversion Factors in the Calculations Workbook



Greener Cleanups: EPA Spreadsheets for Environmental Footprint Analysis
Back Forty - Dig & Haul

Excavation - Off-Site Footprint Part 2

Category	Units	Usage	Energy Conv. Factor	Energy MMBtus	Greenhouse Gas Conv. Factor	Greenhouse Gas lbs CO2	NOx Conv. Factor	NOx lbs	SOx Conv. Factor	SOx lbs	PM Conv. Factor	PM lbs	HAPs Conv. Factor	HAPs lbs
Offsite waste water treatment														
Waste Disposal	ton	500	0.16	80	25	12500	0.14	70	0.075	37.5	0.4	200	0.0014	0.7
Lab Analysis	$	7725	0.0065	50.2125	1	7725	0.0048	37.08	0.0036	27.81	0.0004	3.09	0.00013	1.00425
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0						
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2							
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2							
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7							
Other fuel extraction and processing	MWh	0	0	0	0	0	0							
	MWh	0	0.69	0	220	0	0.6							

ent 2 | Component 3 | Component 4 | Component 5 | Compone

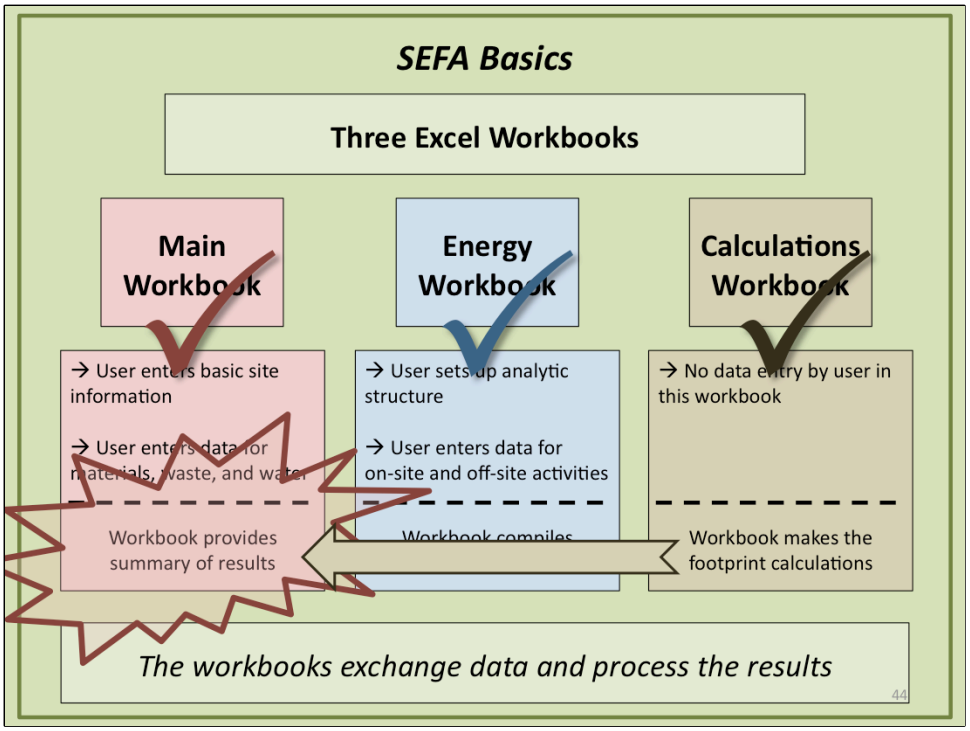
Several pages of footprint calculations

The footprint conversion factors in this table are based on information from public sources and are referenced in EPA's Footprint Methodology

The intermediate results in the Calculations Workbook are useful for understanding nuances of the footprint

The Calculations Workbook sends the results to the Main Workbook

43


SEFA Basics
Three Excel Workbooks
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→ No data entry by user in this workbook
Workbook provides summary of results
Workbook compiles
Workbook makes the footprint calculations
The workbooks exchange data and process the results
44

Summary Table – Showing Energy and Emissions

Core Element	Metric	Unit of Measure	Footprint					
			Site Investigation	Excavation	Soil to Landfill	Backfill	Groundwater Monitoring	Total
Materials & Waste	Refined materials used on-site	Tons	0	10	0	0	0	10
	% of refined materials from recycled or waste material	%						0%
	Unrefined materials used on-site	Tons				7000	0	8,500
	% of unrefined materials from recycled or waste material	%				29%		24%
	On-site hazardous waste disposed of off-site	Tons	10	0	3,500	0	0	3,510
	On-site non-hazardous waste disposed of off-site	Tons	0	500	7500	0	0	
	% of total potential waste recycled or reused	%	0%	80%	0%			
Water	On-site public water use (by source)	MG	0	3	0	2	0	
Energy	Total energy used	MMBtu				735	226	12,175
	Total energy voluntarily derived from renewable resources							
	- Biodiesel use and on-site generation power					0	0	
	- Voluntary purchase of renewable electricity					0	0	
	- Voluntary purchase of RECs	MW				0	0	
Air	On-site NOx, SOx, and PM emissions	Pound	11	39	0	0	1	1,467
	On-site HAP emissions		0	0	0	0	0	0
	Total NOx, SOx, and PM emissions		738	2017	15724	262	305	19,746
	Total HAP emissions		8	5	21	1	4	38
	Total greenhouse gas emissions		43	125	697	62	17	944

amount of energy used

TOTALS

Energy

MMBtu

NOx, SOx, PM

GHG emissions

TOTALS

Air Emissions

lbs

tons CO2e

Summary Table – Showing Energy and Emissions

Core Element	Metric	Unit of Measure	Footprint					
			Site Investigation	Excavation	Soil to Landfill	Backfill	Groundwater Monitoring	Total
Materials & Waste	Refined materials used on-site	Tons	0	10	0	0	0	10
	% of refined materials from recycled or waste material	%		0%				0%
	Unrefined materials used on-site	Tons	0	1500	0	7000	0	8,500
	% of unrefined materials from recycled or waste material	%		0%		29%		24%
	On-site hazardous waste disposed of off-site	Tons	10	0	3500	0	0	3,510
	On-site non-hazardous waste disposed of off-site	Tons		500	7500	0	0	8,000
	% of total potential waste recycled or reused	%	0%	0%	0%			15%
Water	On-site public water use (by source)	MG		3	0	2	0	4
Energy	Total energy used	MMBtu	336	1891	8767	735	226	12,175
	Total energy voluntarily derived from renewable resources							
	- Biodiesel use and onsite [illegible]	MMBtu	0	0	0	0	0	-
	- Voluntary purchase of renewable electricity	MWh	0	0				-
	- Voluntary purchase of RECs	MWh	0	0				-
Air	On-site NOx, SOx, and PM emissions	Pounds	117	939				1,467
	On-site HAP emissions	Pounds	0	0				0
	Total NOx, SOx, and PM emissions	Pounds	738	2017				19,746
	Total HAP emissions	Pounds	8	3				
	Total greenhouse gas emissions	Tons CO2e	43	125				944

NOW WE HAVE COMPLETED ALL OUR FOOTPRINT METRICS !!

How do we present and interpret the results?

Preparing Results for Presentation

Back Forty (Hypothetical Site)

Emphasize certain points

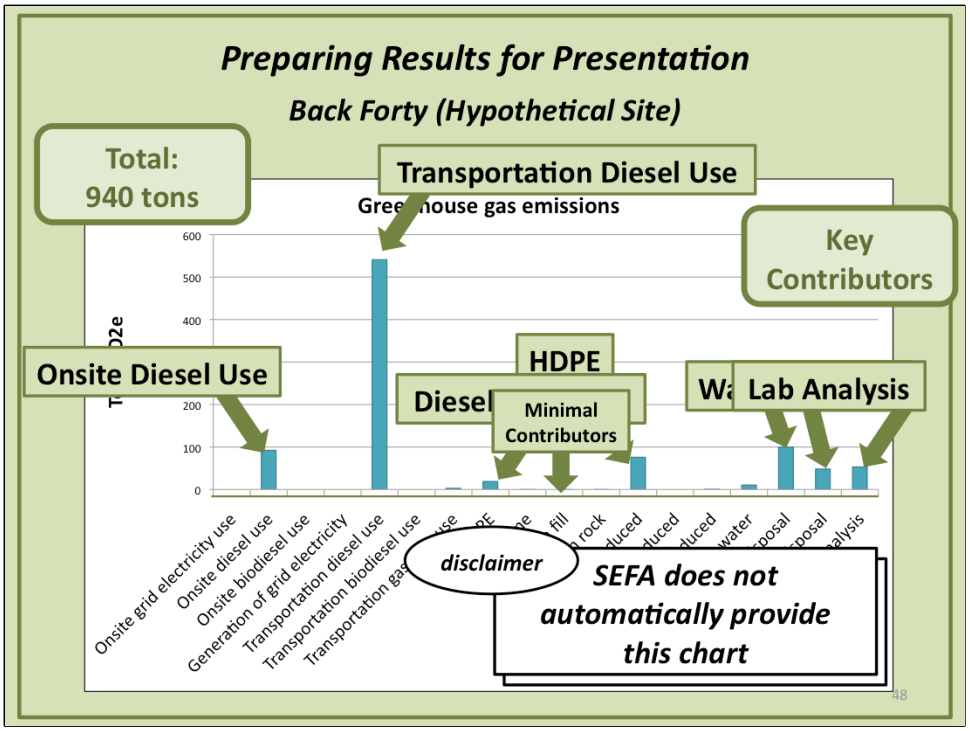
Simplify the metrics – those of greatest importance to our site

Units that are appropriate to our site

Totals only

Metric	Estimated Footprint	Units
Refined materials used on-site	10	Tons
Unrefined materials used on-site	8,500	Tons
On-site hazardous waste disposed of off-site	3,510	Tons
On-site non-hazardous waste disposed off-site	8,000	Tons
On-site public water used	1,200	1000 gal
On-site groundwater used	-	1000 gal
Total energy used	12,200	MMBtu
Total energy voluntarily derived from renewable resources	-	MMBtu
Total NOx emissions	12,200	Pounds
Total SOx emissions	2,400	Pounds
Total PM emissions	5,100	Pounds
Total HAP emissions	40	Pounds
Total greenhouse	940	Tons CO2e

What is contributing to this CO2e footprint?


Preparing Results for Presentation
Back Forty (Hypothetical Site)
Total: 940 tons
Transportation Diesel Use
Key Contributors
Onsite Diesel Use
HDPE
Minimal Contributors
Lab Analysis
disclaimer
SEFA does not automatically provide this chart
600
500
400
200
100
0
Onsite grid electricity use
Onsite diesel use
Onsite biodiesel use
Generation of grid electricity
Transportation diesel use
Transportation biodiesel use

Testing Alternative Scenarios

What if….

… I use reclaimed water instead of public water for dust control? ?

… I use biodiesel instead of conventional diesel? ?

… I conduct more extensive site investigation, leading to reduction of the amount of soil sent to the landfill? ?

SEFA can be used to test alternative scenarios

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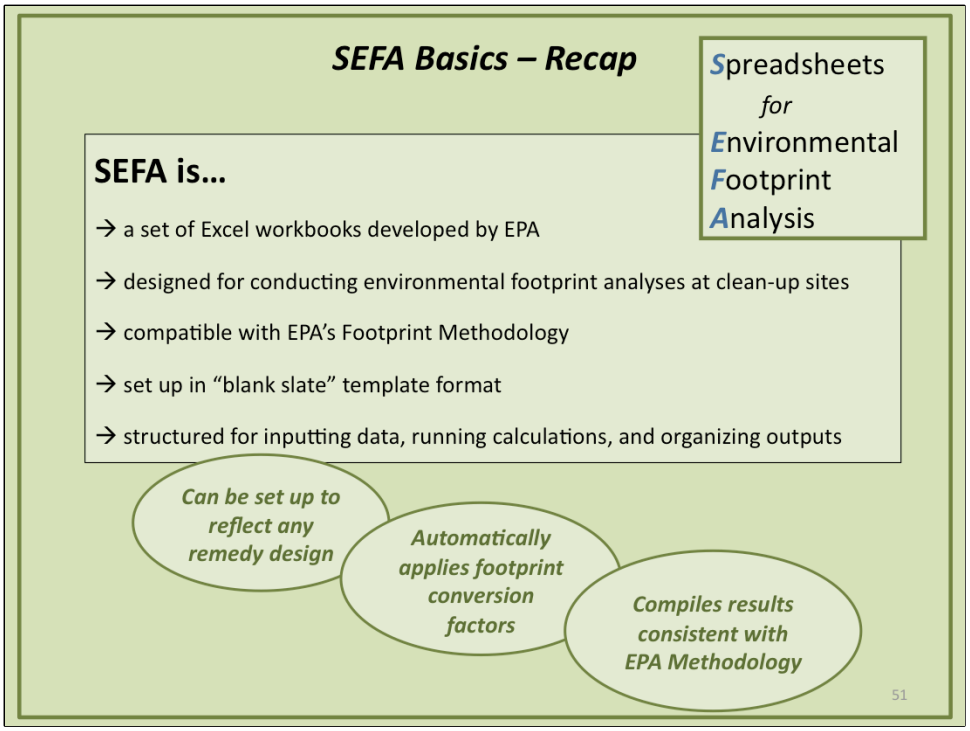
Additional Features in SEFA

SEFA has additional features such as:

- **Tracking renewable energy sources**
- **Specifying local power mix for grid electricity**
- **Establishing unique footprint conversion factors**
- **Modeling carbon storage (e.g. from planting trees)**

These and other features in SEFA allow flexibility for accurately modeling specific site and remedy conditions.

50


SEFA Basics – Recap
Spreadsheets for Environmental Footprint Analysis
SEFA is…
→ a set of Excel workbooks developed by EPA
→ designed for conducting environmental footprint analyses at clean-up sites
→ compatible with EPA's Footprint Methodology
→ set up in "blank slate" template format
→ structured for inputting data, running calculations, and organizing outputs
Can be set up to reflect any remedy design
Automatically applies footprint conversion factors
Compiles results consistent with EPA Methodology
51

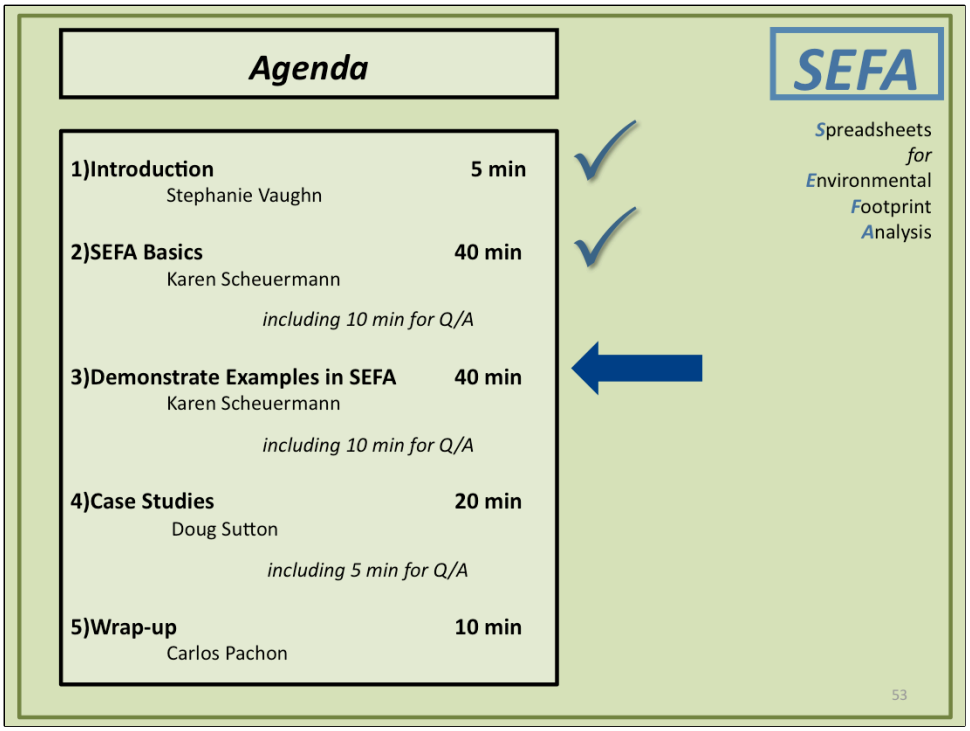
SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Q/A on SEFA Basics

SEFA and EPA's Footprint Methodology are posted at: www.cluin.org/greenremediation/methodology/index.cfm

52


Agenda
SEFA
Spreadsheets
for
Environmental
Footprint
Analysis
1)Introduction 5 min
Stephanie Vaughn
2)SEFA Basics 40 min
Karen Scheuermann
including 10 min for Q/A
3)Demonstrate Examples in SEFA 40 min
Karen Scheuermann
including 10 min for Q/A
4)Case Studies 20 min
Doug Sutton
including 5 min for Q/A
5)Wrap-up 10 min
Carlos Pachon
53

SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Demonstration Examples in SEFA

The demonstration workbooks reflect the same hypothetical site as the screenshots

An additional activity – a pump and treat system – has been added to help illustrate key features

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Demonstration Examples in SEFA

(A) Brief walk-through of the workbooks

→ *Highlight some features that don't show up on screenshots*

→ *Will not visit every tab in the workbooks*

(B) Demonstrate three of the key features of SEFA

→ *Add a new activity to the remedy*

→ *Provide the fuel mix for grid electricity*

→ *Add new remedy material with unique footprint conversion factors*

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Demonstration Examples in SEFA

Instructor opens SEFA Workbooks and demonstrates examples in the worksheets

All three workbooks must be open at the same time

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SEFA Demonstration Examples – Recap

→ *this has been a very simplistic site and remedy*

→ *for a real site, can enter as much or as little detail as may be appropriate*

SEFA provides:

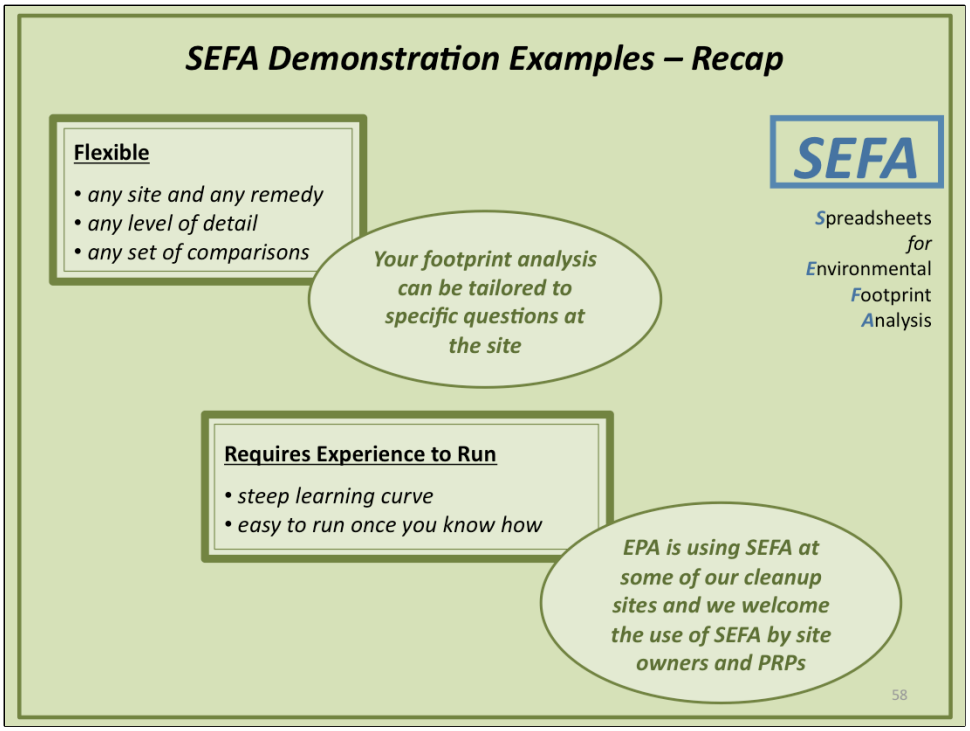
→ *format for data entry*
→ *application of footprint conversion factors*
→ *compilation of results*

The user:

→ *sets up structure of analysis to reflect site*
→ *provides all remedy inputs and documentation*
→ *enters data directly into the spreadsheets*

Tutorial illustrating many additional features of SEFA available on Cluin

57


SEFA Demonstration Examples – Recap
Flexible
• any site and any remedy
• any level of detail
• any set of comparisons
Your footprint analysis can be tailored to specific questions at the site
SEFA
Spreadsheets for Environmental Footprint Analysis
Requires Experience to Run
• steep learning curve
• easy to run once you know how
EPA is using SEFA at some of our cleanup sites and we welcome the use of SEFA by site owners and PRPs
58

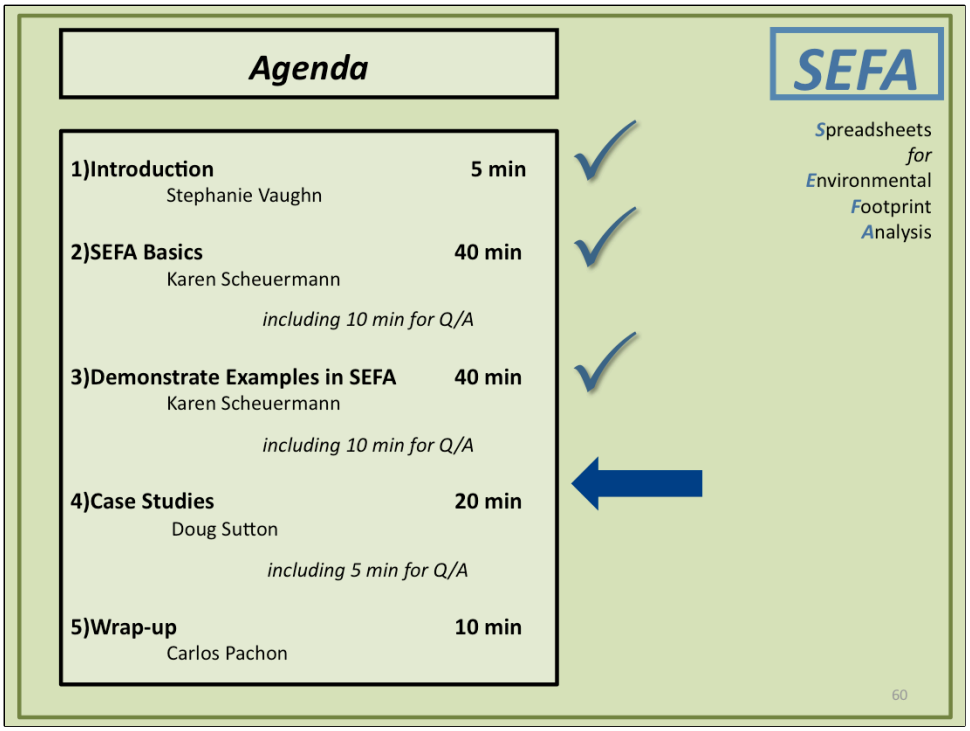
SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Q/A on Demonstration Examples

SEFA and EPA's Footprint Methodology are posted at: www.cluin.org/greenremediation/methodology/index.cfm

59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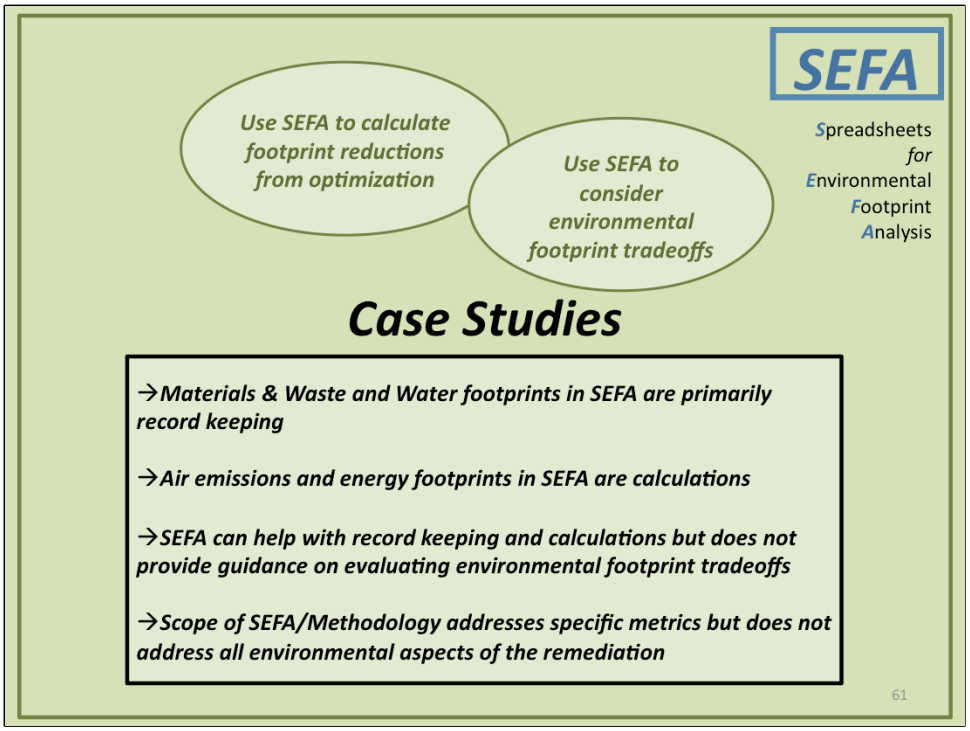
including 5 min for Q/A
5)Wrap-up 10 min
Carlos Pachon
60


SEFA
Spreadsheets for Environmental Footprint Analysis
Use SEFA to calculate footprint reductions from optimization
Use SEFA to consider environmental footprint tradeoffs
Case Studies
→Materials & Waste and Water footprints in SEFA are primarily record keeping
→Air emissions and energy footprints in SEFA are calculations
→SEFA can help with record keeping and calculations but does not provide guidance on evaluating environmental footprint tradeoffs
→Scope of SEFA/Methodology addresses specific metrics but does not address all environmental aspects of the remediation
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Materials & Waste Case Study
Optimization of Acid Mine Drainage Treatment Plant in EPA Region 10

Optimization review evaluated potential reuse of precipitated metals from acid mine drainage that are currently stored on site

- *5,000 to 10,000 tons of dry solids generated each year and stored on site*
- *200,000 tons of dry solids already in Central Impoundment Area*
- *14% of dry solids is manganese*

Recommendation: Potential to reuse manganese in manufacturing sector (steel, batteries, chemicals). Contact potentially interested parties.

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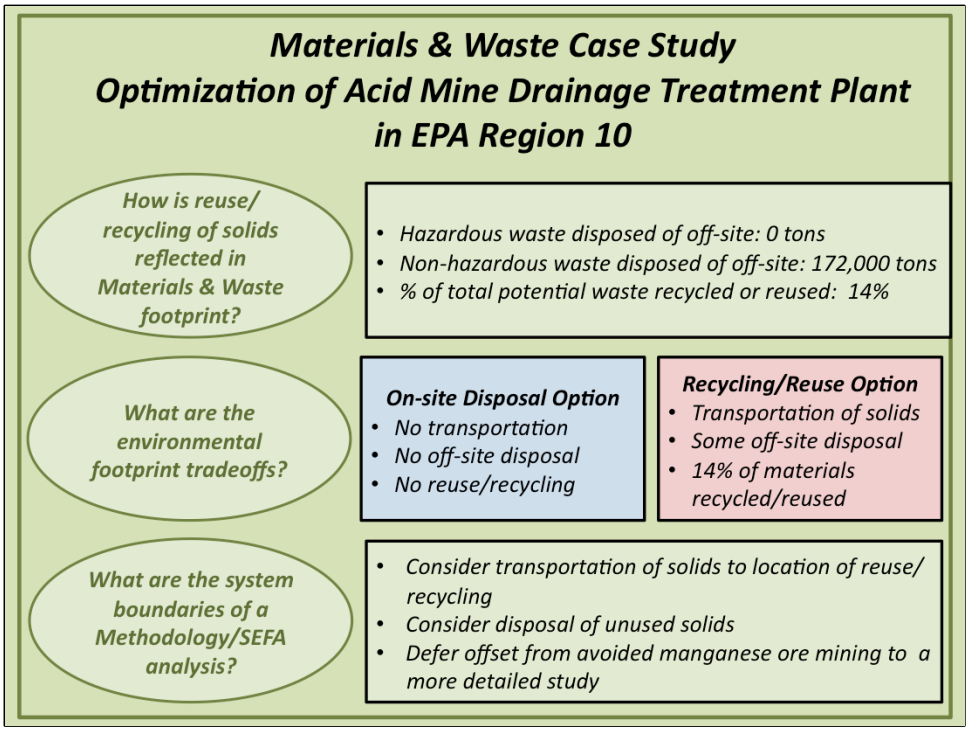
Materials & Waste Case Study
Optimization of Acid Mine Drainage Treatment Plant in EPA Region 10
How is reuse/ recycling of solids reflected in Materials & Waste footprint?
• Hazardous waste disposed of off-site: 0 tons
• Non-hazardous waste disposed of off-site: 172,000 tons
• % of total potential waste recycled or reused: 14%
What are the environmental footprint tradeoffs?
On-site Disposal Option
• No transportation
• No off-site disposal
• No reuse/recycling
Recycling/Reuse Option
• Transportation of solids
• Some off-site disposal
• 14% of materials recycled/reused
What are the system boundaries of a Methodology/SEFA analysis?
• Consider transportation of solids to location of reuse/ recycling
• Consider disposal of unused solids
• Defer offset from avoided manganese ore mining to a more detailed study

Water Case Study
Water Footprint of Groundwater Remedy in EPA Region 10

Groundwater remedy

- *800 gpm of extracted water treated and provided to public water supply*
- *135 gpm seep intercepted, treated and discharged to natural receiving surface water body*

Water Resource	Description of Quality of Water Used	Volume Used (1000 gallons)	Uses	Fate of Used Water
Public water supply				
Extracted groundwater #1 Location: **City Wells** Aquifer: **Deschutes River Alluv.**	Drinking water quality	420,000	Treated with air stripping to adjust pH and remove VOCs	Public water supply
Extracted groundwater #2 Location: **Sub drain** Aquifer: **Vashon Drift**	Surface expression/seep	71,000	Aeration to remove VOCs and discharged	Naturally receiving surface water body

Remedy has essentially no water footprint.

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Air Emissions Case Study
Groundwater Remedy in EPA Region 6

Optimization recommendation: streamline proposed treatment system

Design Parameters

- *Design influent concentrations: TCE < 50 µg/L and cis-1,2-DCE < 70 µg/L*
- *Groundwater reinjection standards: TCE 5 µg/L and cis-1,2-DCE 70 µg/L*
- *Expected flow rate: 150 gpm*

Original Design

- *Air stripping and liquid phase granular activated carbon (LGAC) polishing*
- *Air stripper off-gas treated with vapor phase GAC (VGAC)*
- *Dispersive agent likely needed to avoid scaling caused by air stripping*

Streamlined Design

- *LGAC without air stripping*
- *LGAC with changeouts based on TCE (not cis-1,2-DCE) breakthrough*
- *Benefits:*
  - *Avoid aeration and scaling*
  - *Avoid off-gas treatment*

Air Emissions Case Study
Groundwater Remedy in EPA Region 6

Change in Inventory

- *Decrease scale inhibitor by 20 drums*
- *Decrease electricity usage by over 100,000 kWh*
- *Decrease VGAC use by 25,000 lbs*
- *LGAC use unchanged*

Before

SEFA

After

Estimated Footprint Reductions

- *CO2 – 280,000 lbs per year*
  - *~78% from electricity reductions*
  - *~20% from materials reductions*
- *NOx + SOx +PM – 2,200 lbs per year*
- *HAPs – 4 lbs per year*
- *All air emission reductions are global reductions*
- *No appreciable change in on-site air emissions*

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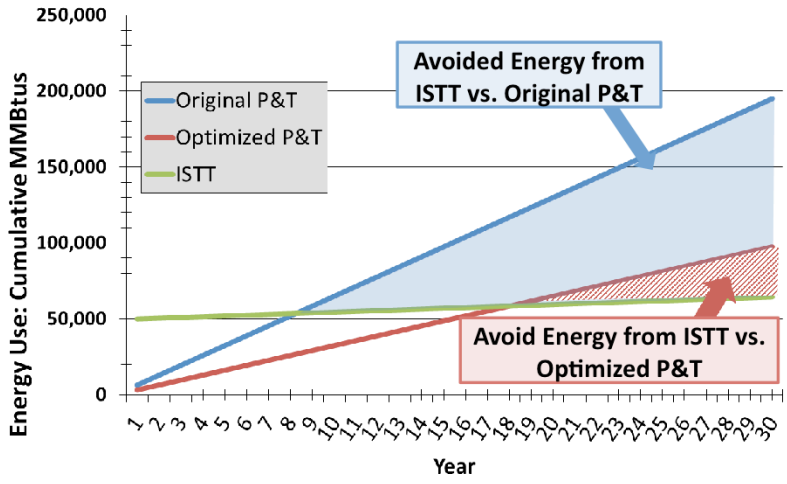
Energy Case Study
Optimization of Chlorinated Solvents Site in EPA Region 1



Disclaimer: SEFA does not automatically provide charts like this

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SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Q/A on Case Studies

BMP Fact Sheets are posted at:
www.clu-in.org/greenremediation/

"Profiles of Green Remediation" are posted at:
www.clu-in.org/greenremediation/tab_d.cfm

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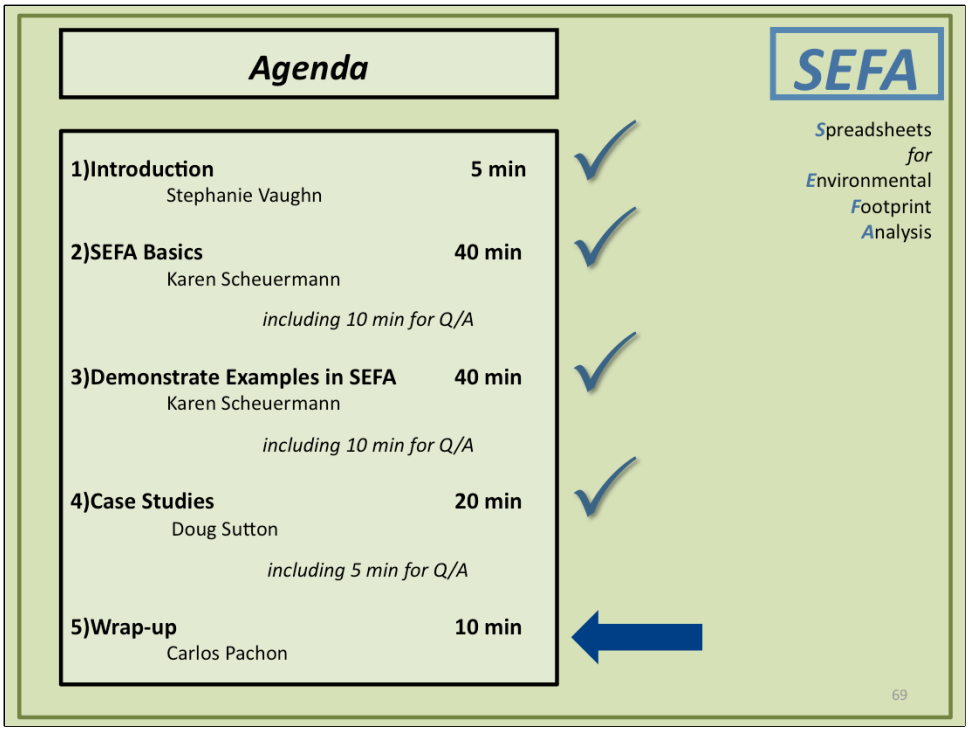
Agenda
SEFA
Spreadsheets
for
Environmental
Footprint
Analysis
1)Introduction 5 min
Stephanie Vaughn
2)SEFA Basics 40 min
Karen Scheuermann
including 10 min for Q/A
3)Demonstrate Examples in SEFA 40 min
Karen Scheuermann
including 10 min for Q/A
4)Case Studies 20 min
Doug Sutton
including 5 min for Q/A
5)Wrap-up 10 min
Carlos Pachon
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SEFA

Spreadsheets
for
Environmental
Footprint
Analysis

Wrap-up/Questions/Discussion

→ ***SEFA is one part of EPA's Greener Cleanups effort***

→ ***The SEFA worksheets, along with a tutorial, are available on EPA's Clu-in website***

→ ***EPA is continuing to use SEFA for our footprint analyses***

→ ***We welcome the use of SEFA by site owners and PRPs***

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Estimating Environmental Footprints Using SEFA

Thank you for your interest in Greener Cleanups!

Resources

EPA's Footprint Methodology *www.cluin.org/greenremediation/methodology/index.cfm*

SEFA Worksheets and Tutorial
www.cluin.org/greenremediation/methodology/index.cfm

BMP Fact Sheets
www.clu-in.org/greenremediation/

Profiles of Green Remediation
www.clu-in.org/greenremediation/tab_d.cfm

Archived Webinars
www.clu-in.org/greenremediation/subtab_b6.cfm

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