

Modernizing data pipelines for accessible and actionable insights

Jadey Ryan

Data Scientist , WSDA

WSU NWREC Lunch & Learn

January 16, 2025



Washington
State Department of
Agriculture

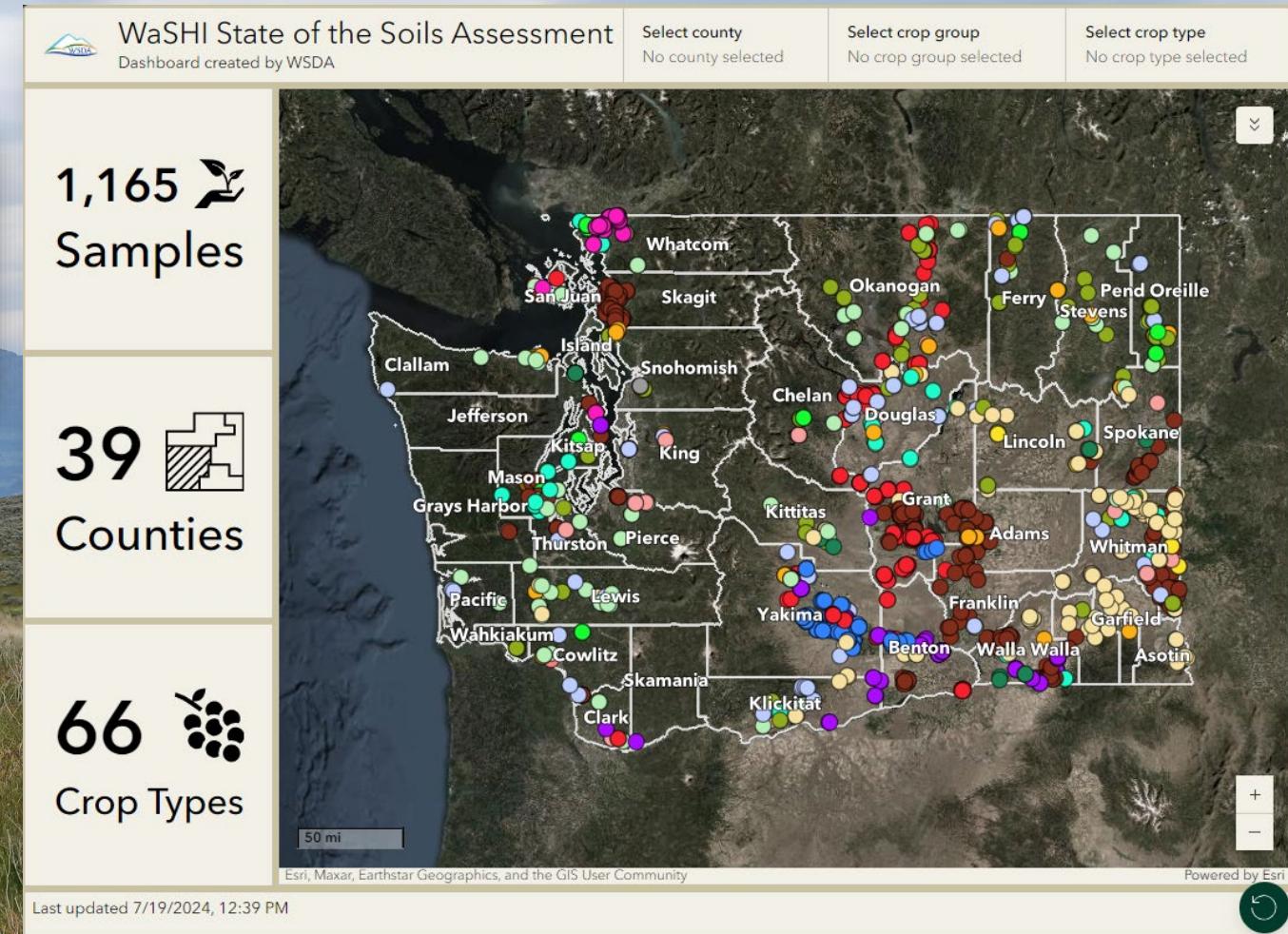
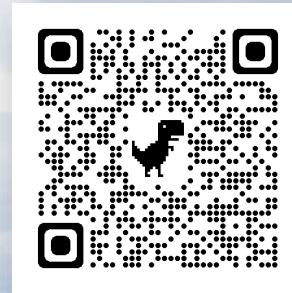


WASHINGTON STATE
UNIVERSITY



State of the Soils Assessment collected 1,165 samples & provided 400+ custom reports over 5 years.

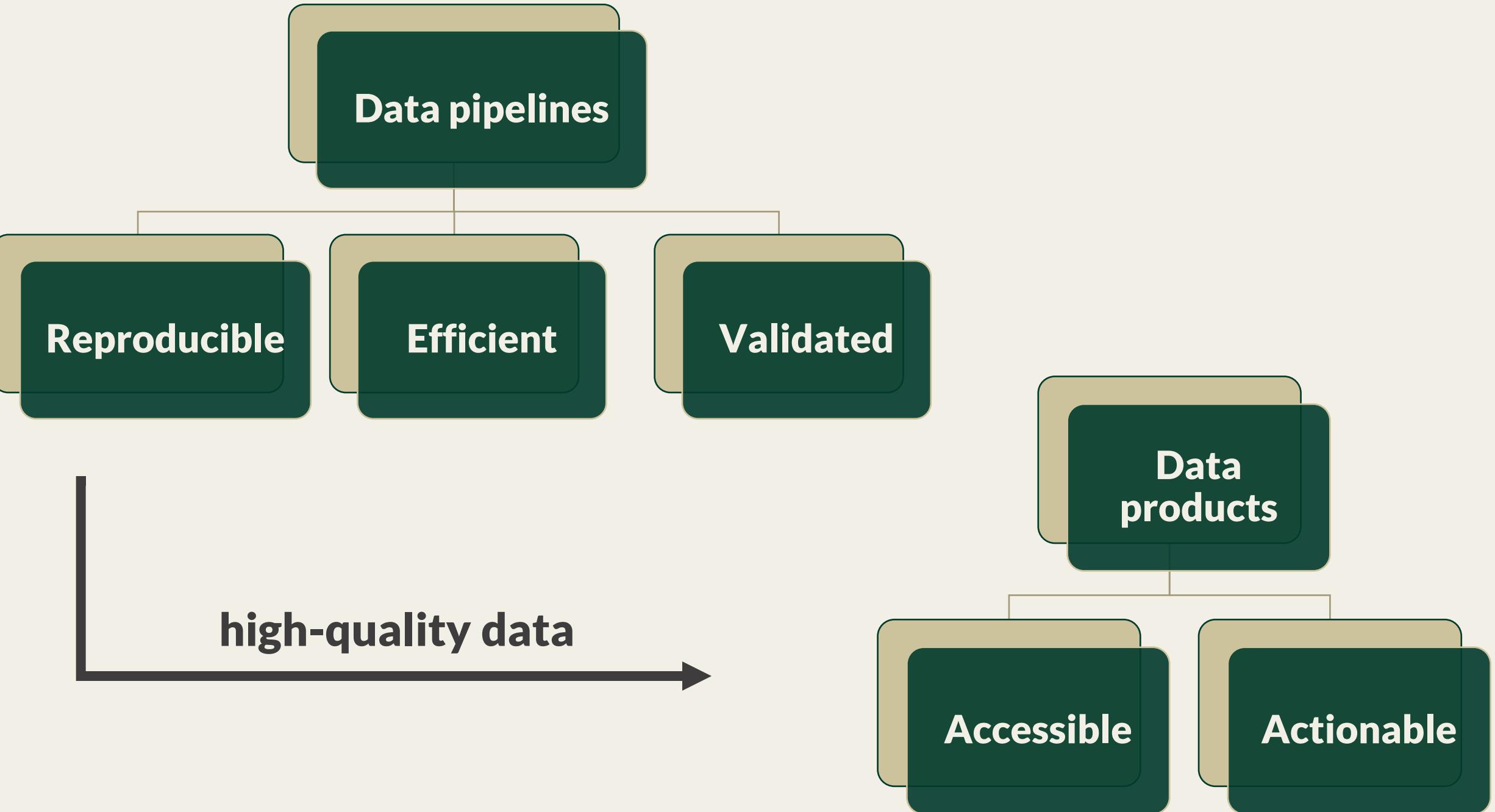
Scan or click! →



Leslie Michel

Data pipeline





Pipeline tools & technologies



Pen & Paper



MS Excel



MS Word



ArcGIS

Online

Field Maps



Survey123



GitHub



Art by Jack Corbett

Before: assign sample IDs & provide labels

Site Code and Label Cheat Sheet

Site Code and Sample ID

Each sample is assigned a unique Site Code and a Sample ID. Site Code and Sample ID are similar and only distinguished by the additional depth indicator for the Sample ID. Both include the County ID, Producer ID, Treatment ID, and Field ID. Sample ID includes a sampling depth for each soil sample.

		Item	Description or Abbreviation
Site Code (County - Field ID)	Sample ID (County - Depth)	County	First three letters
Producer ID	Starting at 001, ascribed by CD	Producer ID	
Treatment ID	See below table, select option for the primary treatment	Treatment ID	
Field ID	Starting at 01 for each producer	Field ID	
Depth	0" to 6" = A, 6" to 12" = B, 0" to 12" = C, Bulk Density = Bd	Depth	

Counties that have the same first three letters will be abbreviated as follows:

- Clark – CLK
- Kitsap – KIP
- Klickitat - KLK
- Grays Harbor – GRH
- Skamania – SKM

Treatment	Option 1	Option 2	Option 3	Option 4
Land type	Cropland (CL)	Conservation reserve program (CRP)	Native prairie (NP)	Rangeland (RNG)
Tillage	Conventional till (CT)	Strip till (ST)	No till (NT)	
Lime application	Lime application (L)	No lime application (NL)		
Cover crop	Cover crop (CC)	No cover crop (NCC)		
Pesticide application	Conventional (CON)	Organic (ORG)		

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

Initials: _____ CD: _____

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

Initials: _____ CD: _____

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

Initials: _____ CD: _____

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Initials: _____ CD: _____

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

Initials: _____ CD: _____

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

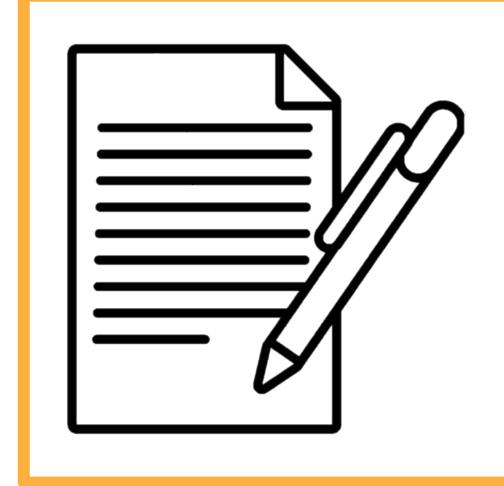
Initials: _____ CD: _____

Project: WSDA SHI

Sample ID: _____

Date: _____ Depth: _____

Initials: _____ CD: _____



After: assign sample IDs & provide labels

The image shows a screenshot of an RStudio interface. On the left, there is an R script named "assign-sample-ids.R". The code is as follows:

```
R assign-sample-ids.R
165 # Assign IDs =====
166
167 ## Read combined sample requests <- read_excel(
168 # Read updated farm info
169 farm_info <- readRDS("farm_info.RDS")
170 ## Producer IDs
171 # Join producer info from producers <- full_join(
172 # distinct(requests, on = "producer_id")
173 # distinct(farm_info,
174 #   by = c("producer_id", "farm_id"))
175 # Join producer info from producers <- full_join(
176 # distinct(requests, on = "producer_id")
177 # distinct(farm_info,
178 #   by = c("producer_id", "farm_id"))
179 # Join producer info from producers <- full_join(
180 # distinct(requests, on = "producer_id")
181 # distinct(farm_info,
182 #   by = c("producer_id", "farm_id"))
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185 # distinct(farm_info,
186 #   by = c("producer_id", "farm_id"))
187 # Join producer info from producers <- full_join(
188 # distinct(requests, on = "producer_id")
189 # distinct(farm_info,
190 #   by = c("producer_id", "farm_id"))
```

The R logo is visible in the bottom left corner of the RStudio window.

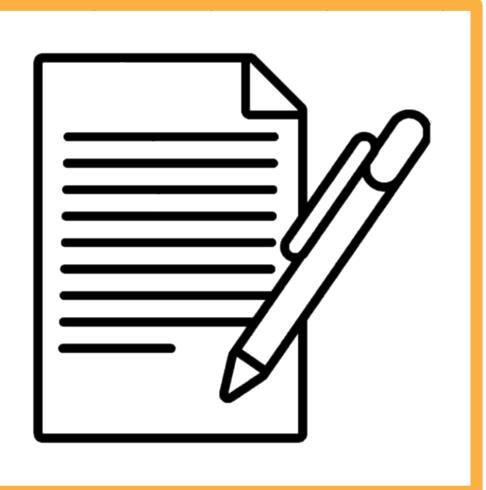
In the center, a Microsoft Word Mail Merge dialog box is displayed. It contains fields for "Project: WaSHI SOS 2024", "Organization: WSDA", "Sample ID: 24-WAH001-01", "Date: ___/___/24 Initials: ___", and "Project: WaSHI SOS 2024". Below the dialog, there are three more sets of identical fields for Sample IDs 02, 03, and 04, each with a "W" icon and a "Start Mail Merge" button.

The right side of the slide contains three columns of identical text, representing the output for Sample IDs 01, 02, and 03 respectively:

Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-01	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-01	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-01	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-02	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-02	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-02	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-03	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-03	Date: ___/___/24 Initials: ___
Project: WaSHI SOS 2024	Organization: WSDA	Sample ID: 24-WAH001-03	Date: ___/___/24 Initials: ___

Before: field forms

Soil Health Assessment – Field Form					
Natural Resources Assessment Section Washington State Department of Agriculture					
https://agr.wa.gov/departments/land-and-water/natural-resources/soil-health					
Dani Gelardi: DGelardi@agr.wa.gov 360-791-3903 Olympia Leslie Michel: LMichel@agr.wa.gov 509-731-9895 Yakima					
General Information					
Date	Site Arrival Time	County	Weather		
6/13/2022	8:45	Yakima	great! wind 1-2 mph		
Organization	Sampler Initials	Crop	Sample ID		
WSDA	DG	Hops	22-SCBG-H-04W		
Data Collection					
	Point 1	Point 2	Point 3	Point 4	Point 5
Bulk density: Mark which points were sampled for BD.	X	X			X
Irrigation: (Ex. Is it actively being irrigated?)					
Soil moisture: Estimate if saturated, at field-capacity, or dry.	field capacity				
Disease/stunted growth: Describe any signs of disease.					
Photo: Mark if a photo was taken and describe the observation.					
Additional Notes:					
intercropped					



A	B	C	D	E	F	G
sampleId	dateTime	crop	irrigation	soilMoisture	diseaseStunted	notes
1 22-CLA001-01-A	5/27/2022 10:00	Pasture	no	sat	no	
2 22-CLA001-02-B	5/27/22 11:00	Pasture	no	sat	no	
3 22-CLA002-01-C	4/26/22 12:00	Market, Brassica, And O	drip	3 fc, 2 sat	no	
4 22-CLA002-02-C	4/26/22 13:00	Cover Crops	drip, drip, drip, no, no	4 fc, 1 sat	no	
5 22-CLA003-01-A	5/27/2022 15:00	Pasture	no	sat	no	
6 22-CLA003-02-B	5/27/2022 14:00	Pasture	no	sat	no	
7 22-CLA006-01-H	4/20/22 10:00	Vegetable (Peppers)	drip	fc - dry	na	
8 22-CLA006-02	4/20/22 10:30	Blueberry	yes	fc	no	
9 22-CLA006-03	4/20/22 9:45	Squash	no	4 fc, 1 sat	no	
10 22-CLA006-04	4/20/22 11:00	Orchard	no	sat	no	
11 22-CLA006-05-H	4/20/22 11:30	Vegetable (Brassica Or	drip	slightly moist	no	
12 22-CLA008-01	4/21/22 9:00	Pasture	no	fc	no	
13 22-CLA009-01	4/19/22 11:00	Meadow	no	fc	no	
14 22-CLA009-02	4/19/22 12:00	Pollinators	no	3 sat, 2 fc	no	meadow scaping
15 22-DOU004-03-B	4/26/22 8:25	Wheat	no	dry	no	field 2 - pasture
16 22-DOU007-03-C	5/3/22 9:30	Canola	no	dry	yes, no plants present	uniform wheat, lower levels
17 22-DOU017-01-C	5/3/22 8:35	Wheat	no	4 fairly dry with some moisture, 1 dry top 2"	field is newly rolled over to	canola crop was sown in durin
18 22-DOU017-02-C	4/25/22 15:00	CRP/Conservation	no	dry	na	grasses appear healthy and lu
19 22-DOU018-01-D	4/25/22 11:52	Wheat	no	dry	no	small amount of litter left on



After: field forms



Cancel Collect Submit

GPS accuracy 36 ft · 30 ft required

24-KIN002-01 point 5

47. °N 121. °W

Update Point

Take Photo Attach

SAMPLE POINT SELECTION *

Complete before going into the field.

Project *

WSDA Partnerships in Soil Health ✓

Ecology Direct Seed

Sample ID assigned by WSDA (ex. 24-ADA024-01) *

24-KIN002-01

Crop planted at time of sampling *

Market Crops

Sample point number *

5

Create 5 points in the same soil series for each sample. Zoom in to the field scale to see the soil series.

FIELD FORM *

Complete when arriving at each sample point.

WSDA Partnerships in Soil Health ✓

Cancel Collect Submit

24-KIN002-01 point 5

47. °N 121. °W

Take Photo Attach

SAMPLE POINT SELECTION *

Complete before going into the field.

Project *

WSDA Partnerships in Soil Health ✓

Ecology Direct Seed

Sample ID assigned by WSDA (ex. 24-ADA024-01) *

24-KIN002-01

Crop planted at time of sampling *

Market Crops

Sample point number *

5

Create 5 points in the same soil series for each sample. Zoom in to the field scale to see the soil series.

FIELD FORM *

Complete when arriving at each sample point.

Cancel Collect Submit

24-KIN002-01 point 5

47. °N 121. °W

Zoom in to the field scale to see the soil series.

FIELD FORM *

Complete when arriving at each sample point.

Show or hide field form *

Show when sampling

Date and time arrived at sample point *

1/13/25, 10:26 AM

Sampler name *

JM

Bulk density collected? *

Yes ✓

No

Collect bulk density at 3 of the 5 sample points.

Any unusual or interesting observations?

Weedy cover crops

ex. signs of disease or active irrigation
If helpful, attach a photo.

Before: management surveys

	A	B	C	D	E	F	G	H	I	J	K	
1	SAMPLE IDENTIFICATION						TILLAGE (for cash crop)					
2	Site Code	Crop Type	Years in Current Management	Number of crops (including cover crops) in one full	Years of Typical Crop Rotation	Percentage of year with live roots present	Tillage System	Subsoil Tillage (deep ripping) Used	Year of last tillage	Primary Tillage Implement	Secondary Tillage Implement	Ave Tillage C
3	FRA001CT01	Corn, Field	3-5	2 2-4	40-60	Conventional Till	No	2021	Turbotill	Drill, double disk		
4	FRA001CT02	Alfalfa Hay	3-5	1 5-8	40-61	Conventional Till	No	2021	Turbotill	Drill, double disk		
5	FRA001RNG03	CRP/Conservation	>20	0 Not applicable	80-100	Never Tilled	No	Never Tilled	Not applicable	Not applicable		

	A	B	C	D	E	F	G	H	I	J	K	L
1	SAMPLE IDENTIFICATION						TILLAGE (for cash crop)					
2	Site Code	Years Current Management	Crop Type	Years in Current Management	Number of crops (including cover crops) in one full rotation	Years of Typical Crop Rotation	Percentage of year with live roots present	Tillage System	Subsoil Tillage (deep ripping) Used	Year of last tillage	Primary Tillage Implement	Secondary Implement
3			Alfalfa Hay	1-2		Not applicable	Not applicable	Never Tilled	Yes	Not applicable	Not applicable	Not applicable
4			Alfalfa Seed	3-5		1	0-20	No-till	No	Within 1 week	Aerway	Aerway
5			Alfalfa/Grass Hay	5-10		2-4	20-40	Minimum Till		Within 1 month	Chisel plow	Chisel plow
6			Alkali Bee Bed	10-20		5-7	40-60	Conventional Till		Within 3 months	Chisel plow, with sweep	Chisel plow, with sweep
7			Allium	>20		8-10	60-80			Within 1 year	Cultipacker	Cultipacker
8			Apple			>10	80-100			More than 1 year ago	Drill, double disk	Drill, double disk
9			Apricot							More than 3 years ago	Drill, hoe/chisel	Drill, hoe/chisel
10			Asparagus								Drill, single disk	Drill, single disk
11			Barley								Field Cultivator	Field Cultivator
12			Barley Hay								Field Cultivator, with spike	Field Cultivator
13			Bed								Harrow, coiled tine	Harrow, coiled tine
14			Hay								Harrow, pasture	Harrow, pasture
15			Marbanzo								Harrow, rotary	Harrow, rotary
16			Peen								Harrow, spiked tooth	Harrow, spiked tooth

X

After: management surveys



SAMPLE IDENTIFICATION

Farm name:^{*}

Field name:^{*}

Your name:^{*}

Unique sample ID for this field:^{*}
(Enter the identical string of characters provided by WSDA)

Back Next

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BASIC FIELD INFORMATION

What is currently planted at the time of soil sampling?^{*}
Be as specific as possible!

Ex: Hemp, Spinach (seed), Nursery (lavender), Corn (field), Hay (oat)
Ex: Cover crops (legumes and brassica), Timothy, Fallow (tilled), Fallow (idle)

Approximately when when this crop planted?
Skip this question if not applicable.

MM/DD/YYYY

Approximately how many times has this crop been planted in the field's history?^{*}

-Please select-

Please enter the field history for the last 5 years:

Be as specific as possible!

Example:
2024: Fallow (tilled)
2023: Fallow (idle), Tomato, Broccoli, Cover crop
2022: Cover crop, Tomato, Broccoli
2021: Fallow, Watermelons, Fallow
2020: Pear orchard (removed in spring)

2024: *

Before: QA/QC lab results

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	county	crop	sampleid	date	time	QC_notes	totalN_%	totalC_%	TOC_%	OM_%	poxC_mg.kg	24hrmin.C_mgC.kg.day	96hrmin.C_mgC.kg.day	amt.mg.
2	Asotin	wheat_fallow	ASO001NT01	6/21/2021	0:00:00		0.11374	1.47365	1.47365	2.45	300		33.725	
3	Asotin	wheat_fallow	ASO001NT02	6/21/2021	0:01:00		0.10699	1.3785	1.3785	2.3	341		26.25	
4	Asotin	wheat_fallow	ASO002NT01	7/21/2021	0:02:00		0.14491	2.01225	2.01225	3	464		22.5	
5	Asotin	CRP	ASO003CRP01	6/24/2021	0:03:00		0.09639	0.99438	0.91438	1.7	217.5		45	
6	Asotin	wheat_fallow	ASO003NT01	7/21/2021	0:04:00		0.09882	1.1306	0.9856	1.6	247.5		37.5	
7	Benton	wheat_fallow	BEN001NT01	7/21/2021	0:05:00		0.06116	0.37396	0.33896	0.75	183.5		15	
8	Benton	CRP	BEN002CRP01	6/23/2021	0:06:00		0.06946	0.51007	0.39507	0.95	240		35.625	
9	Benton	wheat	BEN002CT01	6/23/2021	0:07:00		0.06557	0.47945	0.47945	0.85	175.5		26.25	
10	Columbia	wheat_fallow	COLO02NL722	6/9/2021	0:08:00		0.12367	1.62855	1.62855	2.8	329.5		41.25	
11	Columbia	wheat_fallow	COLO04NL733	5/12/2021	0:09:00		0.13091	1.78665	1.78665	2.85	412		50.625	
12	Columbia	wheat_fallow	COLO06NL662	5/12/2021	0:10:00		0.10492	1.23707	1.23707	2	139.5		50.6	
13	Columbia	pea_dry	COLO08NL372	6/8/2021	0:11:00		0.10113	1.19601	1.19601	1.95	120		31.875	
14	Columbia	alfalfa_hay	COLO09NL971	5/12/2021	0:12:00		0.08637	0.85669	0.85669	1.7	187		28.125	
15	Columbia	pea_dry	COLO10NL582	6/10/2021	0:13:00		0.09613	1.16808	1.11308	2	118		48.75	
16	Columbia	wheat_fallow	COLO12NL202	5/12/2021	0:14:00		0.16156	2.2784	2.2784	3.8	419		43.125	
17	Columbia	wheat_fallow	COLO14NL422	5/12/2021	0:15:00		0.11267	1.3079	1.3079	2.3	197		28.125	
18	Columbia	wheat_fallow	COLO18NL131	5/12/2021	0:16:00		0.08865	0.86296	0.86296	1.55	75.5		16.875	
19	Columbia	wheat_fallow	COLO20NL152	5/12/2021	0:17:00		0.09629	1.0755	1.0755	1.95	317.5		43.125	
20	Douglas	CRP	DOU004CRP01	6/18/2021	0:18:00		0.06382	0.57784	0.57784	1.15	301		18.75	
21	Douglas	pasture	DOU004RNG01	6/18/2021	0:19:00		0.06371	0.44198	0.44198	1.4	335		31.875	
22	Douglas	wheat_fallow	DOU006NT01	6/18/2021	0:20:00		0.09486	0.75548	0.70548	1.5	363.5		35.625	
23	Douglas	wheat_fallow	DOU006NT02	6/17/2021	0:21:00		0.10444	0.81524	0.81524	2.1	353.5		26.25	
24	Douglas	alfalfa_hay	DOU007AL01	6/18/2021	0:22:00		0.13352	0.95942	0.80442	1.95	475		52.5	
25	Douglas	pasture	DOU007RNG01	6/18/2021	0:23:00		0.05961	0.50447	0.49447	1.1	174.5		22.5	
26	Douglas	wheat_fallow	DOU016CC01	6/17/2021	0:24:00		0.08599	0.50144	0.50144	1.35	304		22.5	
27	Douglas	CRP	DOU016CRP01	6/17/2021	0:25:00		0.07743	0.64407	0.58407	1.15	219.5		31.875	
28	Franklin	corn_field	FRA001CT01	6/28/2021	0:26:00		0.07078	0.58464	0.45464	1.55	303.5		41.25	
29	Franklin	alfalfa_hay	FRA001CT02	6/28/2021	0:27:00		0.0791	0.69075	0.54075	1.4	463.5		18.75	
30	Franklin	pasture	FRA001RNG03	6/28/2021	0:28:00		0.04364	0.23035	0.08535	0.55	150.5		22.5	
31	Grant	pasture	GRA001CL01	6/8/2021	0:29:00		0.13518	1.3164	1.1514	1.75	369.5		46.875	
32	Grant	bean_dry	GRA002CT01	6/7/2021	0:30:00		0.0814	0.72476	0.72476	0.65	159		18.75	
33	Grant	garlic	GRA003CL01	6/8/2021	0:31:00		0.11147	0.96569	0.96569	1.15	289.5		18.75	
34	Grant	bean_dry	GRA004CL01	6/8/2021	0:32:00		0.11624	1.07515	0.88515	1.25	327.5		45	



After: QA/QC lab results

Table of contents

2024 Season Summary

Summary Stats: All Years

Summary Stats: 2024 vs 2016 - 2023

Qualified Data

2024 Results

QC Summary of 2016 - 2024 Results

AUTHOR

Jadey Ryan

PUBLISHED

October 22, 2024

2024 S
Notes

Suspect Data (Z-score is $\geq |3|$)

Excel

Column visibility ▾

Search:

- 191 samples
- 27 countries
- 15 crops
- 30 crop varieties
- 99 products

sample_id

All

measurement

value

z_score

Summary

Measurements

ace_g_protein

amm_n_mg

b_mg_kg

bd_g_cm3

24-CLL005-01

24-CLL005-02

24-FER009-01

24-FER010-03

24-GRA035-01

24-GRA035-03

24-GRA035-03

24-GRA035-03

Showing 1 to 9 of 614 entries

NDs and Other Qualified Data

Excel

Column visibility ▾

Search:

sample_id

All

measurement

All

qc_tag

All

value

All

result_detection_limit

All

24-CHE011-01

s_mg_kg

Non-detect

2.34

3.1

24-CHE011-01

b_mg_kg

Non-detect

0.01

0.01

24-CHE011-02

s_mg_kg

24-CHE011-02

b_mg_kg

24-CHE012-01

b_mg_kg

24-CHE012-02

s_mg_kg

24-CHE013-01

nitrate_n_mg_kg

24-CHE013-01

pmn_28day_mg_kg

literate programming with:



Showing 1 to 9 of 132 entries

After: QA/QC lab results

Pointblank Validation Series

Project Metadata

DATA FRAME sos-project-metadata

WARN

1

STOP

-

NOTIFY

-

STEP	COLUMNS	VALUES	TBL	EVAL	UNITS	PASS	FAIL	W	S	N	EXT
1	project_id is not null col_vals_not_null()	project_id	—	O→	✓	7	7 1.00	0 0.00	○	—	—
2	project_name is not null col_vals_not_null()	project_name	—	O→	✓	7	7 1.00	0 0.00	○	—	—
3	project_description is not null col_vals_not_null()	project_descri...	—	O→	✓	7	7 1.00	0 0.00	○	—	—
4	project_organization is not null col_vals_not_null()	project_organisi...	—	O→	✓	7	7 1.00	0 0.00	○	—	—
5	project_organization_type is not null col_vals_not_null()	project_organizi...	—	O→	✓	7	7 1.00	0 0.00	○	—	—
6	project_contact_name is not null col_vals_not_null()	project_contac...	—	O→	✓	7	7 1.00	0 0.00	○	—	—
7	project_contact_email is not null col_vals_not_null()	project_contac...	—	O→	✓	7	7 1.00	0 0.00	○	—	—
8	project_id is unique rows_distinct()	project_id	—	O→	✓	7	7 1.00	0 0.00	○	—	—
9	project_organization is valid col_vals_in_set()	project_organizi...	Adams CD, Asotin...	⬇️	✓	12	12 1.00	0 0.00	○	—	—
10	project_organization_type is valid col_vals_in_set()	project_organizi...	Conservation Dis...	⬇️	✓	12	12 1.00	0 0.00	○	—	—
11	project_contact_email is valid col_vals_within_spec()	project_contac...	email	⬇️	✓	12	12 1.00	0 0.00	○	—	—

2025-01-08 10:18:34 PST

2.2 s

2025-01-08 10:18:36 PST



Before: create reports



Soil Health Assessment Results

WSDA | WASHINGTON STATE UNIVERSITY | SOIL HEALTH INITIATIVE

ASO001

Fall 2021

Farm: ASO001

Thank you for being a participant in our [State of the Soils Assessment](#). This work would not be possible without your collaboration and input.

Over the past two summers, WSDA, WSU, and multiple conservation districts traveled across Washington to sample over 400 fields in more than 20 crops. We are excited to share with you some preliminary results with data from your fields.

The goals of our project are to **1)** Evaluate the current soil health status and priorities for crops across Washington; **2)** Calibrate soil health scoring curves relevant for Washington's soils, climates, and cropping systems; and **3)** Further understand how soil management affects important soil functions.

Project Team:

WSU

Audrey Griffin LaHue, Asst. Prof, Soil Health
Potter, Postdoctoral Scholar
McIlquham, Graduate Student
Bena Sarpong, Graduate Student

WSDA

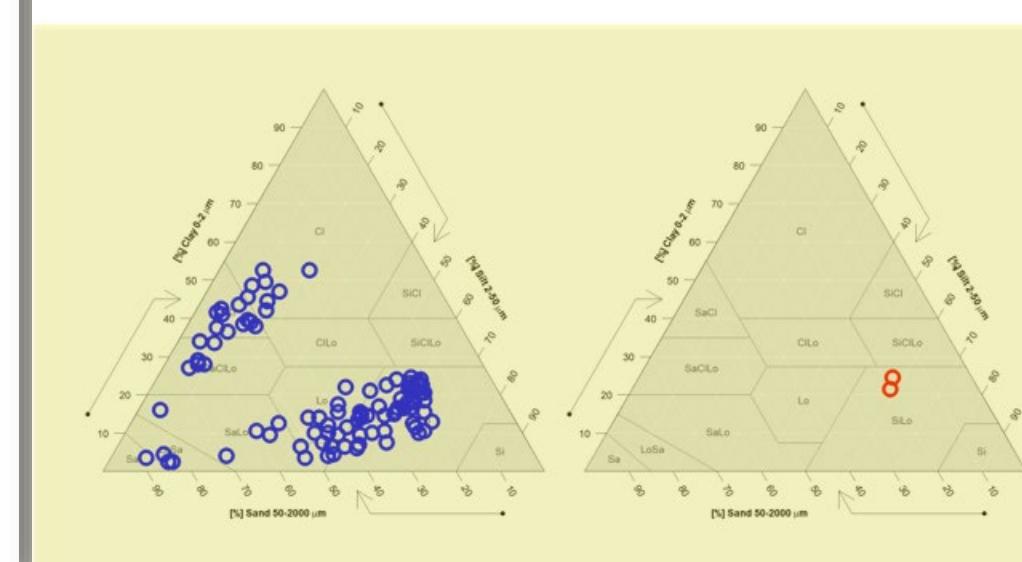
Perry Beale, NRAS Manager
Dani Gelardi, Soil Health Scientist
Leslie Michel, Soil Scientist

Project results

Texture from 0-12 inches

Field	Texture	% Sand	% Silt	% Clay
ASO001NT01	Silt Loam	18	58	24
ASO001NT02	Silt Loam	20	58	22

Texture of all fields in our study



After: create reports



The screenshot shows the RStudio interface for a project named "soils-demo". The left pane displays two files: "01_producer-report.qmd" and "render-reports.R". The "render-reports.R" file contains R code for generating reports. A yellow circle highlights the "Source" button in the toolbar. The right pane shows the "Environment" tab of the sidebar, listing various files and folders within the project directory.

```
1 # Use this script to render all reports at once #####
2
3 # After editing the dataset and optionally the location to move the
4 # rendered reports, click the `Source` button in RStudio.
5
6 # Read in data -----
7
8 # EDIT: Replace `washi-data.csv` with the name of the same dataset used in
9 # 01_producer-report.qmd.
10 data <- read.csv(
11   here::here("data/washi-data.csv"),
12   check.names = FALSE,
13   encoding = "UTF-8"
14 ) |> head(3)
15
16 # Create a df with inputs for quarto::quarto_render() -----
17
18 # This creates a new df called `reports_html` with a row for every unique year
19 # and producer combo for the entire dataset.
20 #
21 # If you want a subset, filter the dataframe to include only the producers you
22 # want to create a report for.
23
24 ## HTML reports
25 reports_html <- data |>
69:1 # Move rendered reports to a different directory
```

soils-demo - RStudio

01_producer-report.qmd x render-reports.R x

Source on Save Run Source

Use this script to render all reports at once

After editing the dataset and optionally the location to move the

rendered reports, click the `Source` button in RStudio.

Read in data -----

EDIT: Replace `washi-data.csv` with the name of the same dataset used in

01_producer-report.qmd.

data <- read.csv(

here::here("data/washi-data.csv"),

check.names = FALSE,

encoding = "UTF-8"

) |> head(3)

Create a df with inputs for quarto::quarto_render() -----

This creates a new df called `reports_html` with a row for every unique year

and producer combo for the entire dataset.

#

If you want a subset, filter the dataframe to include only the producers you

want to create a report for.

HTML reports

reports_html <- data |>

Move rendered reports to a different directory

soils-demo

Environment

Files Plots Packages Help Vi

Home > R > soils-demo

Name

- ..
- .gitignore
- 01_producer-report.qmd
- 02_section-template.qmd
- 03_project-summary.qmd
- 04_soil-health-background.qmd
- 05_physical-measurements.qmd
- 06_biological-measurements.qmd
- 07_chemical-measurements.qmd
- 08_looking-forward.qmd
- 09_acknowledgement.qmd
- data
- images
- R
- resources
- soils-demo.Rproj

Console

Before: store scripts/data



Name
archive-sample-id-assignments
completed-sample-id
returned-sample-requests
01_combined-sample-requests_v6.xlsx
01_combine-sample-request-spreadshe...
02_all-producers_v5.xlsx
02_assign-sample-id_v3.r
02_combined-sample-id_v6.xlsx
03_get-num-producers-fields.r
03_num-producers-fields.xlsx
difference-between-no_v-and_v2.txt
draft-email.docx
sample-id-list.xlsx
sample-request-form.xlsx
sample-request-form-hops.xlsx
sample-request-form-pulses.xlsx

Name
2022_crop-data.csv
2022_crop-data.rdata
2022_lab-results.csv
2022_lab-results.RDS
2022_sample-metadata.csv
2022_sample-metadata.rdata

After: store scripts/data

WA-Department-of-Agriculture / washi-sos ⚡ App is disabled

Type ⌘ to search

Code Issues 4 Pull requests Actions Projects 1 Security Insights Settings

washi-sos (Private)

19 files changed +365 -354 lines changed

Top Search within code

+5 -5

main 1 Branch 0 Tags Go to file

jadeynryan GHA: render README.qmd

.github Fix typo and add changelog to GHA t

2020-2022 More corrections

2023 Update lab methods and MDL for WS

2024 More corrections

R Move validation export into validation

data-sharing Add data request for WSDA equity re

data Fix typo and add changelog to GHA t

intake/dupont-et-al-2021 More corrections

Wi44+,"Chelan","Orchard","Apple","Granny Smith","**Gravelly Sandy**
Loam","Fine",,,,6.5,,5.2,292.3,6.3,,0,,,,,,7
.3,209.7,,1394.2,,131.8,,,8.6,,65.5,173.2,21.9,1
.8,,41.4,,44.1,27.9,27.9,,1,9.2,1.31,25.02,3.57,
,0.3,,,,,,0.6,,0.8.018,263,231,27.
6,11948.1,46.3,29.9,59.8
- 6,2017,"17-CHE005-Wi45-
","Chelan","Orchard","Apple","Granny Smith","**Gravelly Sandy**
Loam","Fine",,,,6.1,,5.3,494.8,6.5,,0.1,,,,
,8.6,190.2,,1356.1,,123.3,,,8.3,,87,154.8,14.4,1
.6,,35.2,,38.4,30.8,30.8,,0.8,11.6,1.66,25.24,3.
61,,0.4,,,,0.8,2.5,0,4.03,256,25
0,24.5,13506.5,45,24,70.1
909 910 910 910

Wi44+,"Chelan","Orchard","Apple","Granny Smith","**Clay**
Loam","Fine",,,,6.5,,5.2,292.3,6.3,,0,,,,,,7
.3,209.7,,1394.2,,131.8,,,8.6,,65.5,173.2,21.9,1
.8,,41.4,,44.1,27.9,27.9,,1,9.2,1.31,25.02,3.57,
,0.3,,,,,,0.6,,0.8.018,263,231,27.
6,11948.1,46.3,29.9,59.8
+ 6,2017,"17-CHE005-Wi45-
","Chelan","Orchard","Apple","Granny Smith","**Clay**
Loam","Fine",,,,6.1,,5.3,494.8,6.5,,0.1,,,,
,8.6,190.2,,1356.1,,123.3,,,8.3,,87,154.8,14.4,1
.6,,35.2,,38.4,30.8,30.8,,0.8,11.6,1.66,25.24,3.
61,,0.4,,,,0.8,2.5,0,4.03,256,25
0,24.5,13506.5,45,24,70.1
Bk32+,"Grant","Orchard","Apple","Honeycrisp","S
ilt
Bk32+,"Grant","Orchard","Apple","Honeycrisp","S
ilt



GitHub

HOW LONG CAN YOU WORK ON MAKING A ROUTINE TASK MORE
EFFICIENT BEFORE YOU'RE SPENDING MORE TIME THAN YOU SAVE?
(ACROSS FIVE YEARS)

		HOW OFTEN YOU DO THE TASK					
		50/DAY	5/DAY	DAILY	WEEKLY	MONTHLY	YEARLY
HOW MUCH TIME YOU SHAVE OFF	1 SECOND	1 DAY	2 HOURS	30 MINUTES	4 MINUTES	1 MINUTE	5 SECONDS
	5 SECONDS	5 DAYS	12 HOURS	2 HOURS	21 MINUTES	5 MINUTES	25 SECONDS
	30 SECONDS	4 WEEKS	3 DAYS	12 HOURS	2 HOURS	30 MINUTES	2 MINUTES
	1 MINUTE	8 WEEKS	6 DAYS	1 DAY	4 HOURS	1 HOUR	5 MINUTES
	5 MINUTES	9 MONTHS	4 WEEKS	6 DAYS	21 HOURS	5 HOURS	25 MINUTES
	30 MINUTES	6 MONTHS	5 WEEKS	5 DAYS	1 DAY	2 HOURS	
	1 HOUR	10 MONTHS	2 MONTHS	10 DAYS	2 DAYS	5 HOURS	
	6 HOURS			2 MONTHS	2 WEEKS	1 DAY	
	1 DAY				8 WEEKS	5 DAYS	

Randall Munroe's xkcd



How do we use reports to make soils data actionable?



Help participants:



Access their soil health data



Interpret within their crop & region context



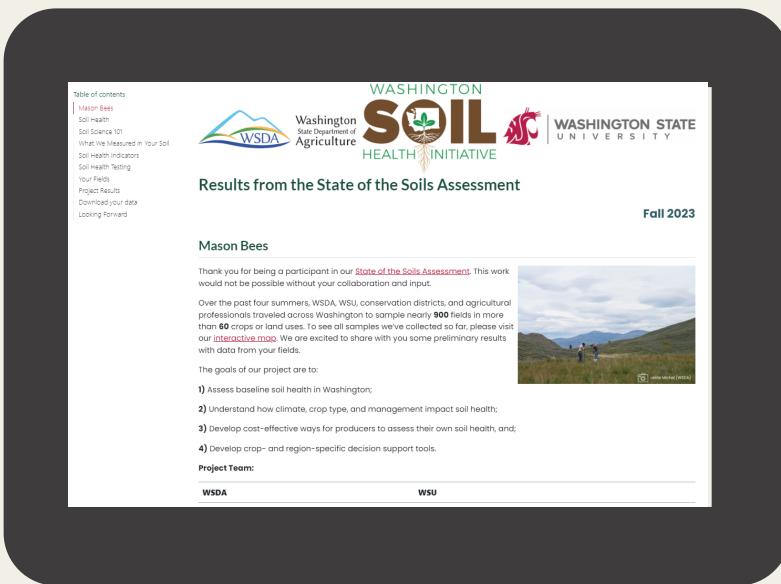
Translate into informed management decisions

Access soil health data



Provide the report in multiple formats

Interactive HTML



Printable PDF

WASHINGTON SOIL HEALTH INITIATIVE | WASHINGTON STATE UNIVERSITY

Results from the State of the Soils Assessment

Fall 2023

Mason Bees

Thank you for being a participant in our [State of the Soils Assessment](#). This work would not be possible without your collaboration and input.

Over the past four summers, WSDA, WSU, conservation districts, and agricultural professionals traveled across Washington to sample nearly **900** fields in more than **60** crops or land uses. To see all samples we've collected so far, please visit our [interactive map](#). We are excited to share with you some preliminary results with data from your fields.

The goals of our project are to:

- 1) Assess baseline soil health in Washington;
- 2) Understand how climate, crop type, and management impact soil health;
- 3) Develop cost-effective ways for producers to assess their own soil health; and,
- 4) Develop crop- and region-specific decision support tools.

Project Team:

WSDA	WSU
Perry Beale, NRAS Manager	Deirdre Griffin Lahue, Asst. Prof, Soil Health
Dani Gelardi, Senior Soil Scientist	Teal Potter, Postdoctoral Scholar
Leslie Michel, Soil Scientist	Molly McQuham, Extension Coordinator
Jadey Ryan, Data Scientist	Kwabena Sarpong, Graduate Student

State of the Soils Assessment

1

Make reports self-contained

- **Don't make recipient hunt down other info**
- **Use plain language**

Soil Health

Soil health is a term that describes how well a soil ecosystem supports plant growth. It includes the physical, chemical, and biological properties of soils that support healthy plants, animals, and people. Healthy soils help reduce the effects of climate change, filter air and water, increase crop productivity, and support rural economies.

Qualities of a Healthy Agricultural Soil

- Good soil tilth allows roots to penetrate
- Near neutral pH (6–8) maximizes nutrient availability for most crops, and minimizes nutrient leaching
- Sufficient—but not excessive—nutrient supply for crop growth
- Small population of plant pathogens and pests
- Adequate soil drainage and infiltration
- Diverse and active microbial population
- Low weed seed bank
- No residual chemicals or toxins that may harm the crop, including salts and nitrates
- Resistance to degradation such as from erosion or surface runoff

Soil Science 101

A crucial part of the soil health journey is measuring changes in your soil. Soil health is measured by soil health indicators, which are measurements. We can measure soil health with a range of indicators, which can relate to important soil functions. Each indicator is affected differently by management.

To learn more about management practices that support healthy soils, see the [U.S. Department of Agriculture \(NRCS\) principles of building soil health](#).

Create accessible data visualizations

- Color contrast
- Convey info with labels, symbols, annotations, etc.
- Text size
- Alternative text



Interpret within crop & region context



Synthesize the latest research

What We Measured in Your Soil



Physical



Biological



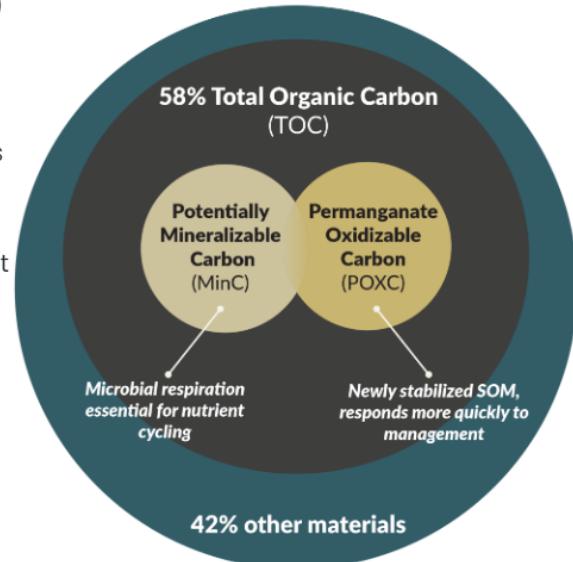
Chemical

Soil Organic Matter (SOM) is the portion of soils not made up of minerals, air, and water, but is instead composed of animal, plant, and microbial matter in various stages of decomposition. SOM is comprised of approximately 58% organic carbon (to convert total organic carbon (TOC) to SOM, an easy rule of thumb is to simply multiply by 2). The remaining portion of SOM includes other essential plant nutrients such as nitrogen, phosphorous, and sulfur. SOM varies by inherent soil and landscape properties such as texture, mineralogy, precipitation, and temperature. It is also greatly impacted by management. To learn more about how to increase SOM, read about the [NRCS principles of building soil health](#). SOM underlies many of the benefits and ecosystem services that soils provide. It has a large impact on almost all other soil properties and is often used as a primary indicator of soil health. However, SOM can be slow to change as the result of management. Because of this, many other indicators have been developed to detect more sensitive components in SOM. Keep reading to learn more.

Potentially Mineralizable Carbon (MinC, frequently referred to as "Soil Respiration") measures the release of carbon dioxide (CO_2) from soil. This measurement is done in a laboratory incubation under controlled conditions "ideal" for microbes. The term mineralization refers to the

Soil Organic Matter (SOM)

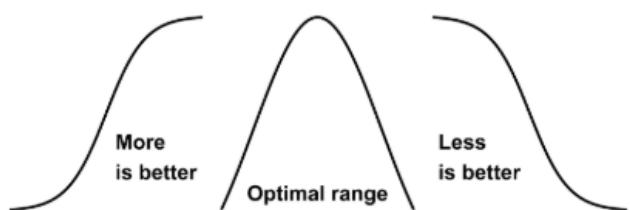
Supports most ecosystems services and soil benefits, but slow to change



Offer context for interpretation

Soil Health Indicators

The below table describes: 1. What each indicator helps measure in your soil; 2. Whether you want the measured value to be higher (more is better), lower (less is better), or in the middle (optimal range); and 3. How often to measure each indicator. Our understanding of these indicators is rapidly evolving as researchers measure them in diverse soils, cropping systems, and climates.



Soil Health Indicator	Soil Function	Scoring Curve Type
Measure every: 1-3 years		
ACE Soil Protein	Nutrient cycling, biodiversity & habitat, filtering & resilience	More is better
Aggregate Stability	Physical support, water relations, biodiversity & habitat, filtering & resilience	More is better
Electrical Conductivity (EC)	Physical support, nutrient cycling, filtering & resilience	Less is better
Mineralizable Carbon	Nutrient cycling, biodiversity & habitat, filtering & resilience	More is better

**more is better,
less is better,
optimal range**

Provide additional resources

Understanding Soil Health Results

Learn more about interpreting your soil health results



Understanding soil tests

SCC Center for Technical Development

Dani Gelardi, WSDA Senior Soil Scientist
Deirdre Griffin LaHue, WSU Assistant Professor
March 14th, 2023



Soil Health Testing

BE CONSISTENT

Sample at the same time each year.

Send samples to the same lab.

Keep samples cool, and get them to the lab quickly.

Keep good records of lab results.



1

CONTEXT MATTERS

Not all soils are created equal!

Indicators are impacted by inherent properties like climate and soil texture, as well as by management.

Don't be alarmed if your soil is below the optimal range for some indicators. See how far you can take your soil with management, but know there may be inherent limitations.

2

HOW TO GET QUALITY RESULTS



BE PATIENT

Some measurements may not change as quickly as you'd like. Sampling across time is very important.

Our scientific understanding of these measurements is evolving! We are all on this journey together.

3

BACK TO THE BASICS

Old school measurements like pH, texture, and SOM are still incredibly important.

New indicators are constantly being developed. Don't feel you have to measure all of them, or let the process overwhelm you.

Have fun exploring through a soil health lens, but remember that you know your soil better than anyone!

Compare with samples from same crop, region, & project in table & plot representations

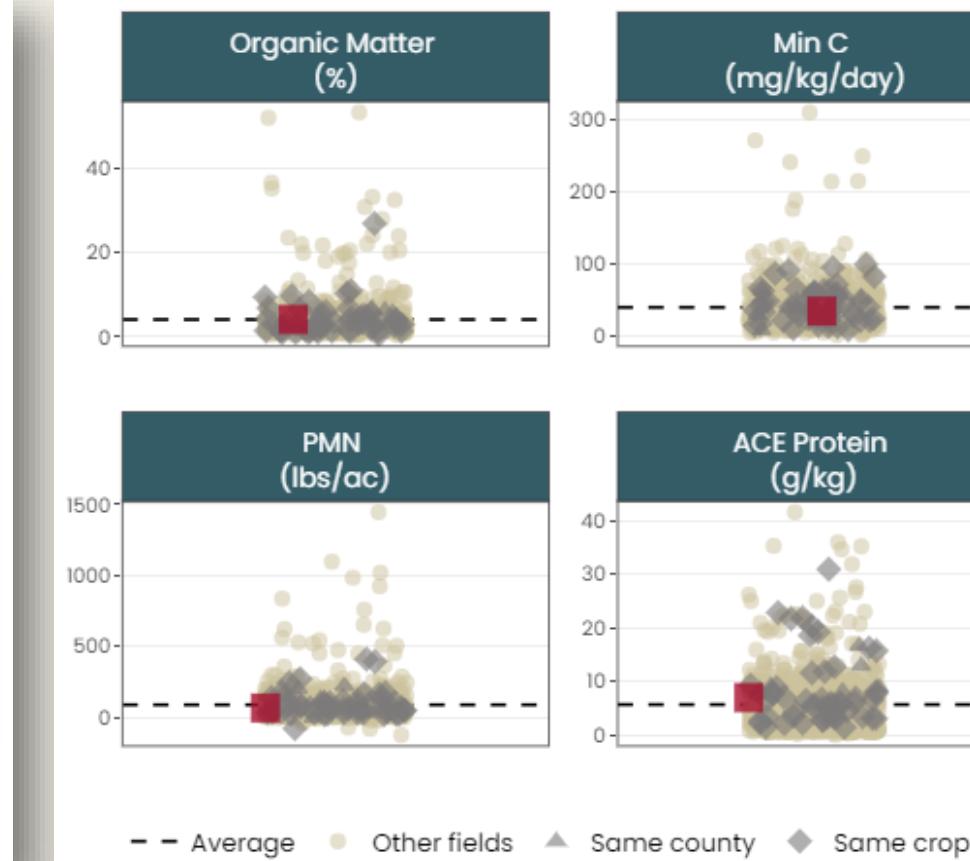
Biological Measurements



Field or Average	Organic Matter	Min C	POXC	PMN	ACE Protein
	%	mg/kg/day	ppm	lbs/ac	g/kg
01	4.2	33.5	462	66.62	6.99
Cowlitz Average (11 Fields)	5.0	40.0	630	120.00	9.00
Native Land Average (54 Fields)	4.2	42.0	520	91.00	8.00
Project Average (877 Fields)	4.2	39.0	450	89.00	5.70

Values ≥ project average have darker backgrounds.

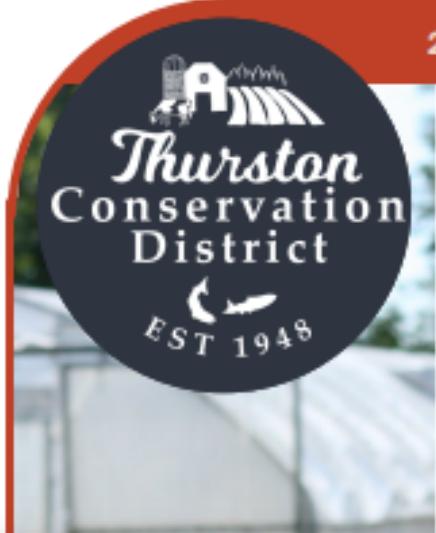
Values < project average have lighter backgrounds.



**Translate into
informed
management
decisions**



Provide amendment recommendations for fertility*



2918 FERGUSON ST SW, TUMWATER WA 98512 • WWW.THURSTONCD.COM • @THURSTONCD [f](#) [t](#) [i](#)

Results

	Results	Rating	Short Interpretation	Recommendation
Nitrate-Nitrogen	6 ppm	Low	Soil nitrate-nitrogen is very low. This is typical for this time of year since nitrate-nitrogen leaches out of the soil with seasonal rains. A standard annual application of nitrogen will be needed this spring.	Add a standard application of nitrogen fertilizer next spring.
Phosphorus	56 ppm	Optimal	Current levels should easily meet the needs of your vegetables.	No action needed.

Making Soils Data Actionable
Washington Soil Health Initiative Webinar Series



Actionable

Chemical
Adam Peterson, Thurston Conservation District
49:15

Making Soils Data Actionable: Chemical Indicators with Adam Peterson



*if qualified and you have enough information

Science still developing for management recommendations based on soil health



The State of the ‘State of the Soils’

Author: Dani Gelardi, Senior Soil Scientist, Washington State Department of Agriculture

How can you make custom reports?



HTML and
PDF Reports

{soils} R package

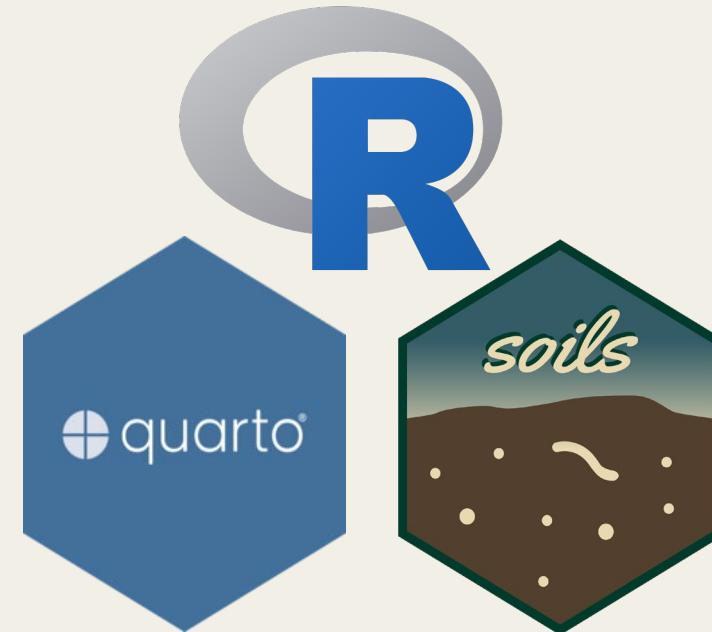
1. comfortable with or willing to learn



2. have soil sampling data*

*for any organization and region

*for multiple project participants



How do you get started?

{soils} package website



soils 1.0.0 Primers ▾ Tutorials ▾ Examples Functions Search

soils



Overview

Introducing {soils}: an R package for all your soil health data visualization and reporting needs. {soils} provides an RStudio project template to generate customized, interactive soil health reports. These reports include plots and tables to show how the participant's results compare to simple averages of results from samples of the same crop, same county, and across the entire project.

Any scientist leading a soil health survey can use {soils} to create custom reports for all survey participants. Democratize your data by giving back to the farmers and land managers who contributed soil samples to your survey project. Use these reports to empower each participant to explore and better understand their data.

The [Washington State Department of Agriculture](#) and [Washington State University](#) produced {soils} as part of the [Washington Soil Health Initiative](#).

Requirements

The report template uses [Quarto](#), which is the [next-generation](#) version of [R Markdown](#). We assume you're using [RStudio v2022.07](#) or later for editing and previewing Quarto documents. We **strongly recommend** you use the [latest release of RStudio](#) for support of all Quarto features. You can also download and install the [latest version of Quarto](#) independently from RStudio.

To render Microsoft Word (MS Word) documents, you must have MS Word installed and activated.

Links
[Browse source code](#)
[Report a bug](#)

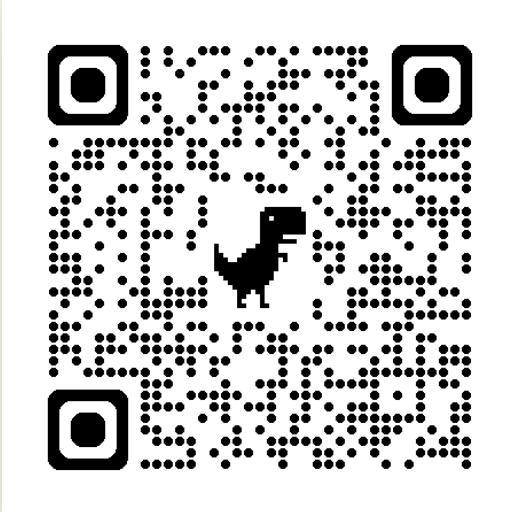
License
[Full license](#)
[MIT + file LICENSE](#)

Citation
[Citing soils](#)

Developers
Jadey N Ryan
Maintainer, author
Molly McIlquham
Author
Kwabena A Sarpong
Author
Leslie M Michel
Author
Teal S Potter
Author
Deirdre Griffin LaHue
Author
Dani L Gelardi
Author

Use or adapt {soils} text & figures

open-source
GitHub repository



WA-Department-of-Agriculture / soils

Code Issues Pull requests Actions Projects Wiki Security Insights

main soils / figures

jadeynryan Add scoring curve figures · 5e71399 · 4 months ago

Name	Last commit message	Last commit date
...		
aggregate-stability-spanish.png		
aggregate-stability.png		
ball-texture-spanish.png		
ball-texture.png		
biological.png		
chemical.png		
compaction-spanish.png		
compaction.png		

Acknowledgement and citation

The below acknowledgement is automatically embedded in each report:

This report was generated using the [{soils} R package](#). {soils} was developed by the Washington State Department of Agriculture and Washington State University, as part of the Washington Soil Health Initiative. Text and figures were adapted from [WSU Extension publication #FS378E Soil Health in Washington Vineyards](#). Learn more about {soils} in this [blog post](#) or this [webinar](#).

To cite {soils} in publications, please use:

Ryan JN, McIlquham M, Sarpong KA, Michel LM, Potter TS, Griffin LaHue D, Gelardi DL. 2024. Visualize and Report Soil Health Survey Data with {soils}. Washington Soil Health Initiative. <https://github.com/WA-Department-of-Agriculture/soils>

Coming Spring – Summer 2025: no-code webapp to generate reports

The image shows a user interface for generating reports. On the left, there's a sidebar with a "Generate Report" title, download and upload icons, and a "Step 1: Download & Fill Out Template" section. It includes options for "Format" (HTML, Word) and "Language" (English, Spanish), and a "Download Template" button. In the center, there's a large preview of a data spreadsheet with 24 rows of field information. The columns include year, sample_id, farm_name, producer, field_name, field_id, county, crop, longitude, latitude, texture, and various soil properties like bd_g_cm3, pmn_lb_a, and nh4_n_m.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	year	sample_id	farm_name	producer	field_name	field_id	county	crop	longitude	latitude	texture	bd_g_cm3	pmn_lb_a	nh4_n_m
2	2023	23-WUY05	Farm 150	WUY05	Field 01		1 County 9	Hay/Silage	-119	49	Clay Loam	1.3	67.13	1.0
3	2022	22-RHM05	Farm 085	RHM05	Field 02		2 County 18	Green Man	-123	47	Sandy Loa	0.88	129.97	21.0
4	2022	22-ENR07	Farm 058	ENR07	Field 02		2 County 11	Vegetable	-122	47	Silt Loam	1.21	122.17	8.0
5	2022	22-ZTD04	Farm 061	ZTD04	Field 03		3 County 13	Herb	-120	46	Silt Loam	1.37	95.24	13.0
6	2023	23-WUY05	Farm 150	WUY05	Field 03		3 County 9	Pasture, S	-119	49	Sandy Loa	1.22	111.35	3.0
7	2022	22-BKG08	Farm 107	BKG08	Field 02		2 County 14	Cereal Gra	-117	47	Silt Loam	1.14	61.92	12.0
8	2023	23-VAY01	Farm 160	VAY01	Field 01		1 County 17	Native Lar	-118	49	Loamy Sa	1.44	-77.9	2.0
9	2022	22-UPD03	Farm 070	UPD03	Field 02		2 County 14	Vegetable	-117	47	Silt Loam	1.24	113.23	12.0
10	2023	23-VWK08	Farm 157	VWK08	Field 01		1 County 23	Vegetable	-123	48	Sandy Loa	0.84	274.24	2.0
11	2022	22-WBI03	Farm 049	WBI03	Field 01		1 County 10	Native Lar	-117	48	Loam	0.98	141.54	19.0
12	2023	23-NFO07	Farm 116	NFO07	Field 01		1 County 20	Forest	-123	46	Loamy Sa	1.04	31.57	4.0
13	2022	22-PUN05	Farm 036	PUN05	Field 01		1 County 8	Commerci	-123	47	Sandy Loa	1.42	94.1	14.0
14	2023	23-RDQ08	Farm 136	RDQ08	Field 02		2 County 7	Commerci	-123	47	Silt Loam	0.78	47.82	30.0
15	2022	22-IOX04	Farm 060	IOX04	Field 08		8 County 13	Herb	-121	46	Silt Loam	1.16	174.39	1.0
16	2022	22-HAO03	Farm 084	HAO03	Field 02		2 County 18	Native Lar	-123	47	Loam	0.96	104.12	22.0
17	2023	23-HDQ07	Farm 158	HDQ07	Field 01		1 County 23	Berry	-123	49	Sandy Loa	0.51	120.1	5.0
18	2022	22-XSL07	Farm 054	XSL07	Field 03		3 County 11	Pasture, S	-122	47	Silt Loam	0.94	147.6	4.0
19	2022	22-RUX09	Farm 092	RUX09	Field 01		1 County 19	Pasture, S	-122	49	Sandy Loa	1.3	157.05	
20	2022	22-COZ08	Farm 063	COZ08	Field 04		4 County 14	Vegetable	-117	47	Silt Loam	1.37	89.53	4.0
21	2023	23-DJU01	Farm 148	DJU01	Field 03		3 County 9	Cereal Gra	-120	48	Loamy Sa	1.27	-6.54	5.0
22	2023	23-TKR05	Farm 167	TKR05	Field 01		1 County 19	Berry	-122	49	Sandy Loa	1.24	33.71	
23	2023	23-OCA05	Farm 124	OCA05	Field 02		2 County 21	Native Lar	-119	49	Sandy Loa	1.06	103.6	3.0
24	2023	23-DHQ03	Farm 180	DHQ03	Field 01		1 County 13	Orchard	-120	46	Silt Loam	1.4	98.82	2.0

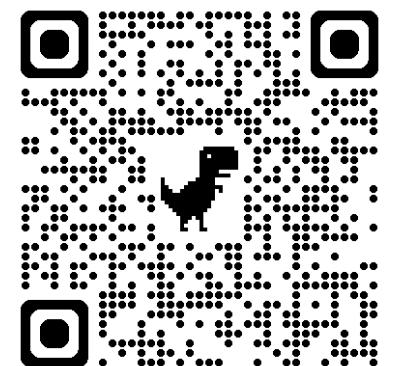
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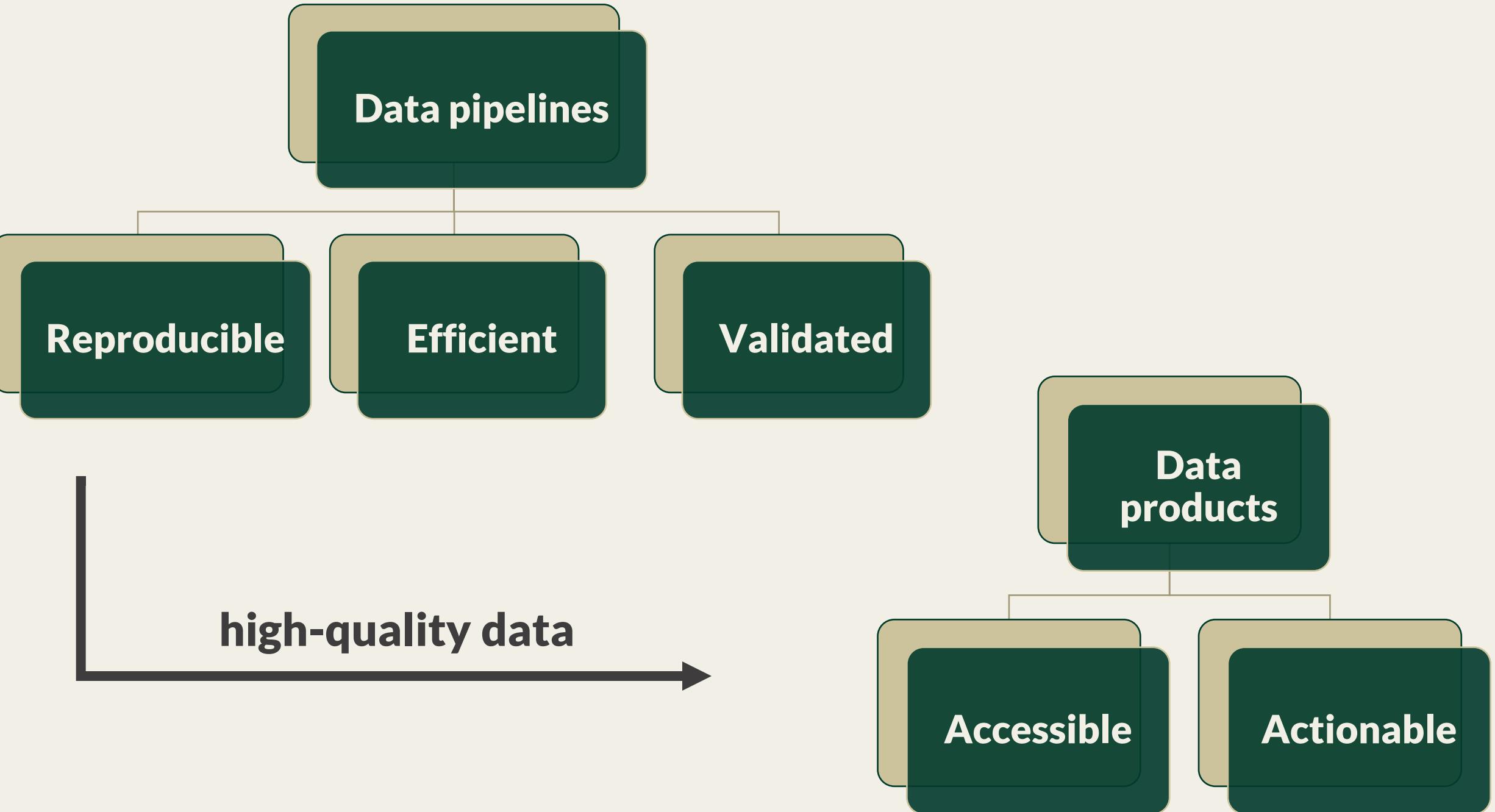
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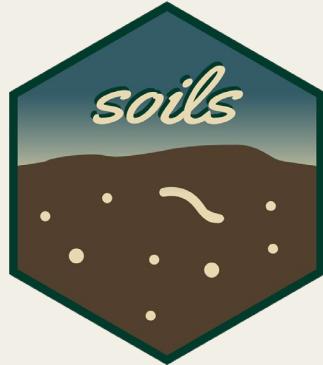
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Resources to learn R, Quarto, and {soils}



- [RStudio Education](#): different starting points to begin learning R
- [R for Data Science \(2ed\)](#): book by Wickham et al. (2023)

- [Get Started with Quarto](#): intro and tutorial
- [20-min technical talk](#): Parameterized soil health reports with Quarto
- [Intermediate Quarto Workshop](#): Parameterized reports with Quarto

- [{soils} package website](#): package documentation & tutorials
- [GitHub repository](#): source code and files
- [WaSHI blog post](#) about {soils}
- [WaSHI Masking Soils Data Actionable webinar](#)

Questions? Comments? Ideas?

Jadey Ryan
jryan@agr.wa.gov



Washington
State Department of
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Leslie Michel