

**Subject:** Fwd: Truterra - EFC Ssurgo data - Specifications  
**Date:** Monday, September 12, 2022 at 15:57:00 Mountain Daylight Time  
**From:** Carlson,Jack <Jack.Carlson@colostate.edu>  
**To:** Case,Shaun <Shaun.Case@ColoState.EDU>  
**CC:** Olaf David <olaf.david@gmail.com>

Shaun,

Digesting the back and forth in the email thread below:

1. Service should return all valid soil components for the mapunits intersected by the TST field. (TST is Truterra Sustainability Tool web application). We're creating a Truterra flavor of wwsoilparams or fppsoilparams, some overlap in output, some new outputs.
2. Dominant component: As with wwsoilparams, the service should return mapunit and soil component extent, and TST can decide which to feature as "dominant".
3. New: Component soil texture at 10 cm (4 inch) depth. For each valid component return texture from horizon where hzdepb\_r > 10 and hzdept\_r < 10. If texture cannot be resolved, return no value (service should not fail). If 10 cm is a horizon breakpoint, return value of lower horizon. Return in component result object.

The reason for 10 cm depth is that it represents the tillage zone (layer) on cultivated land. Shallow surface horizons less than 10 cm on cultivated land mix with horizons below 10 cm, and the lower horizon(s) better represents conditions in the tillage zone.

4. New: Component soil organic matter for (a) surface horizon, (b) weighted averaged om\_r for 0-15 cm, and (c) weighted average for 0-30 cm. Return in component result object.

The reason for weighted average om\_r for the latter two depths is as reference for TST KPI users. Organic matter percentage can translate to soil carbon level, and carbon crediting so far is focused on carbon levels in the top 30cm (12 inches) of the soil.

5. New: Component K Factor at 10 cm (4 inch) depth. If 10cm is a horizon breakpoint, return value of lower horizon. Return in component result object.

6. Wind erodibility (wei): return soil component wei value in component result object.

7. New: Mapunit crop yields. For each valid component, return a 5-output parameter array for all crops associated to the mapunit:

- crop\_key - mucropyldkey from SDM mucropyld table
- crop\_name - cropname from SDM mucropyild table
- nonirr\_yld\_amt - nonirryield\_r from SDM mucropyld table
- irr\_yld\_amt - irryield\_r from SDM mucropyld table
- crop\_yld\_units - yldunits from SDM mucropyld table

8. New: Component crop yields: For each valid component, return a 5-output parameter array for all crops associated to the component:

- crop\_key - cocropyldkey from SDM cocropyld table
- crop\_name - cropname from SDM cocropyild table
- nonirr\_yld\_amt - nonirryield\_r from SDM cocropyld table

irr\_yld\_amt - irryield\_r from SDM cocropyld table  
crop\_yld\_units - yldunits from SDM cocropyld table

9. If Truterra wants another source for crop yield data, for example from NASS, then we should create a separate service with its own logic to do this. The National Commodity Crop Productivity Index (NCCPI), likely the index referred to in the Truterra comments, is generated by NASIS and with version 3 apparently feeds SDM and in turn Web Soil Survey, but is limited to non-irrigated crops. If they want to take that route and integrate NCCPI, we'll need more time to resolve this. For now we should return the mapunit and component crop yields. Also not seeing any NCCPI related tables in our copy of SDM. Wonder if the cropprodindex value in SDM cocropyld table is the NCCPI value. At any rate we need more time to resolve, thus off the table for this week's iteration of the new service.

10. No need to return data in separate horizon objects. Just mapunit result objects and soil component objects within mapunit objects.

Anything else needing clarification or decision?

Jack

Begin forwarded message:

**From:** Jack Carlson <[pspicata@rams.colostate.edu](mailto:pspicata@rams.colostate.edu)>  
**Subject: Re: Truterra - EFC Ssurgo data - Specifications**  
**Date:** August 15, 2022 at 12:00:07 PM MDT  
**To:** "Killi, Ramana" <[rbkilli@landolakes.com](mailto:rbkilli@landolakes.com)>  
**Cc:** "Olaf (EID) "David" <[Olaf.David@colostate.edu](mailto:Olaf.David@colostate.edu)>, Shaun Case <[Shaun.Case@ColoState.EDU](mailto:Shaun.Case@ColoState.EDU)>

Further discussion below.

On Aug 15, 2022, at 11:33 AM, Killi, Ramana <[rbkilli@landolakes.com](mailto:rbkilli@landolakes.com)> wrote:

Hi Jack,

Below is Matt's response to your questions. I will schedule a call on Friday to review your questions and GHG comparison.

Question: return dominant component data only?

- It would be of value to get more than just the dominant component.
  - Will return data for intersected mapunit soil components having majcompflag=yes, including extent so that TST can determine the dominant component.

Question: sometimes a dominant component will be in a non-dominant mapunit. Okay?

- Ok. Dominant component should be more correct than dominant map unit. I believe this will be a change from what was used as "dominant" for Scoring and KPI's. Change is fine, just mentioning for awareness.

Question: okay to have soil texture that occurs at 10cm depth?

- Not sure I'm following this one? Is there not texture data for the surface? What's the reason for the 10cm depth, versus the texture of the 1<sup>st</sup> soil horizon?
  - Surface horizon depths vary from very shallow (1-2 cm) to relatively thick (many cm). On cultivated soils, we probably can assume tillage has mixed up horizon properties down to 30cm. NRCS considers a horizon to be shallow if it is less than 10cm (4 inches). Returning texture at 10cm would seem to realistically reflect surface texture of cultivated soils, and would provide a more realistic response for newly cultivated fields where the land was cleared of trees (which can have very shallow surface horizons), and other very shallow surface horizon edge cases.

Question: okay to have three organic matter outputs?

- I like the 3 OM's they specified.

Question: correct source for crop yield data?

- Seems crop yield would be best sourced from 1<sup>st</sup> – grower data (if we have it), 2<sup>nd</sup> – County crop yield data (most recent year or recent multi-year average) scaled to the soil based on SSURGO yield index.
  - This would involve adapting the NASS yield service, perhaps returning the latest 5-year average, recognizing there are gaps in the NASS county data.
  - Which crops? Am assuming the TST soil service will not know ahead of time which crops the farmer is growing. If not the case, then one or more crop codes should be in the TST soil surface requestion JSON.

Best,  
Ram

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**From:** Jack Carlson <[pspicata@rams.colostate.edu](mailto:pspicata@rams.colostate.edu)>

**Sent:** Wednesday, August 3, 2022 3:58 PM

**To:** Killi, Ramana <[rkilli@landolakes.com](mailto:rkilli@landolakes.com)>

**Cc:** Olaf (EID) "David" <[Olaf.David@colostate.edu](mailto:Olaf.David@colostate.edu)>; Shaun Case <[Shaun.Case@ColoState.EDU](mailto:Shaun.Case@ColoState.EDU)>

**Subject:** Re: Truterra - EFC Ssurgo data - Specifications

Ram,

Some draft "specs" for the service fetching SSURGO data. Recommend a quick review.

Question: return dominant component data only?

Question: sometimes a dominant component will be in a non-dominant mapunit. Okay?

Question: okay to have soil texture that occurs at 10cm depth?

Question: okay to have three organic matter outputs?

Question: correct source for crop yield data?

Jack

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**From:** Killi, Ramana <[rkilli@landolakes.com](mailto:rkilli@landolakes.com)>

**Date:** Thursday, July 28, 2022 at 10:56

**To:** Carlson,Jack <[Jack.Carlson@colostate.edu](mailto:Jack.Carlson@colostate.edu)>, Bhise, Archit <[ABhise@landolakes.com](mailto:ABhise@landolakes.com)>

**Cc:** David,Olaf <[Olaf.David@colostate.edu](mailto:Olaf.David@colostate.edu)>, Serafin,Francesco <[Francesco.Serafin@colostate.edu](mailto:Francesco.Serafin@colostate.edu)>,  
Venigalla, Vamsi <[vvenigalla@landolakes.com](mailto:vvenigalla@landolakes.com)>, Singh, Ruchi <[RSingh@landolakes.com](mailto:RSingh@landolakes.com)>, Mahesh

Pusala <[mahesh.pusala@tavant.com](mailto:mahesh.pusala@tavant.com)>, Kostyanovsky, Kirill <[KKostyanovsky@landolakes.com](mailto:KKostyanovsky@landolakes.com)>,  
Duncan, Matthew <[mduncan01@landolakes.com](mailto:mduncan01@landolakes.com)>, Case,Shaun <[Shaun.Case@ColoState.EDU](mailto:Shaun.Case@ColoState.EDU)>

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**\*\* Caution: EXTERNAL Sender \*\***

Hi All,

Last week during our weekly sync up with CSU, we discussed SSURGO; below is the summary.

- To prioritize the KPI work, SSURGO services work is pushed to august.
- CSU will provide crop yield from SSURGO, but crop yield data is very old for some counties/soils yield was updated 25 years back.
- CSU is willing to provide 11 required attributes, including crop yield data.

**Below are the 11 attributes:**

1. Organic matter, surface horizon (SDM parameter: om\_r): we will return this value  
Note: we can return an organic matter value as a weighted average to a specified depth, for example a root zone depth. Surface horizons vary in depth from a few centimeters to a meter or more.

**Specification: Return three outputs**

**surf\_hz\_om - om\_r for surface horizon**

**valid values: null, 0-100**

**15cm\_om - weighted average horizon om\_r for horizons within hzdept\_r 0 and hzdepb\_r 15**

**skip horizon when om\_r NULL**

**skip cemented and any subsequent horizon within 15 cm of surface**

**valid values: null, 0-100**

**30cm\_om - weighted average horizon om\_r for horizons within hzdept\_r 0 and hzdepb\_r 30**

**skip horizon when om\_r NULL**

**skip cemented and any subsequent horizon within 30 cm of surface**

**valid values: null, 0-100**

2. Predominant soil: do you mean predominant mapunit, predominant soil component within predominant mapunit, or predominant soil component? We can return any of these.

**Specification: Return seven outputs**

**dom\_mukey - dominant soil mapunit key**

**mukey of mapunit having the greatest extent in the AOI**

**dom\_musym - dominant soil mapunit symbol**

**musym of the mapunit having the greatest extent in the AOI**

**dom\_muname - dominant soil mapunit name**

**muname of mapunit having the greatest extent in the AOI**

**dom\_mu\_extent - dominant mapunit extent**

**acreage of intersected mapunit having the greatest extent in the AOI**

**dom\_cokey - dominant soil component key**

**cokey of soil component having the greatest extent in the AOI**

**dom\_compname - dominant soil component name**

**cokey of soil component having the greatest extent in the AOI**

**dom\_comp\_extent - dominant soil component extent**

**cokey extent = intersected mapunit acres \* compct\_r**

3. Wind erodibility (wei): we will return this value (but currently not considered scientifically credible)

**Specification: Return one output**

**dom\_wei - wind erodibility of dominant soil component having greatest extent in the AOI**

4. fips: is this the county or state code? We can return either.

**Specification: Return three outputs**

**area\_symbol: soil survey area symbol from the SDM legend table, e.g. IA067**

**state: alphabetic part of the area\_symbol, e.g. IA**

**county: numeric part of the area\_symbol, e.g. 067**

5. Soil mapunit key (mukey): we will return this key

**Specification: see 2 above**

6. Hydrologic Group (hydgrp): we will return this value

**Specification: Return one output**

**dom\_hydgrp: hydgrp of the soil component having the greatest extent in the AOI**

7. K factor (kfact or kwfact): we will return this value

**Specification: Return one output**

**dom\_kfact: K factor of the soil component having the greatest extent in the AOI**

**If kfact NULL**

**If kwfact NULL**

**dom\_kfact NULL**

Else

**dom\_kffact = kwfact**

Else

**dom\_kffact = kffact**

8. Soil Taxonomic Order (taxorder): we will return this value

**Specification: Return one output**

**dom\_taxorder: Taxonomic order of the soil component having the greatest extent in the AOI**

9. texdesc -> SurfaceSoilTexture

**Specification: Return one output**

**dom\_texture - Surface soil texture of the soil component having the greatest extent in the AOI**

**dom\_texture = texdesc of horizon at 10 cm depth**

10. musym

**Specification: See 2 above.**

11. muname -> Soil

**Specification: See 2 above**

12. Crop Yields

**Specification: return two output parameter arrays**

**dom\_mu\_yields[ ] - crop yields for the mapunit having the greatest extent in the AOI**

**crop\_key - mucropyldkey from SDM mucropyld table**

**crop\_name - cropname from SDM mucropyld table**

**nonirr\_yld\_amt - nonirryield\_r from SDM mucropyld table**

**irr\_yld\_amt - irryield\_r from SDM mucropyld table**

**crop\_yld\_units - yldunits from SDM mucropyld table**

**dom\_comp\_yields[ ] - crop yields for the soil component having the greatest extent in the AOI**

**crop\_key - cocropyldkey from SDM cocropyld table**  
**crop\_name - cropname from SDM cocropyild table**  
**nonirr\_yld\_amt - nonirryield\_r from SDM cocropyld table**  
**irr\_yld\_amt - irryield\_r from SDM cocropyld table**  
**crop\_yld\_units - yldunits from SDM cocropyld table**

Best,  
Ram

---

**From:** Carlson,Jack <[Jack.Carlson@colostate.edu](mailto:Jack.Carlson@colostate.edu)>

**Sent:** Wednesday, July 13, 2022 9:32 AM

**To:** Bhise, Archit <[ABhise@landolakes.com](mailto:ABhise@landolakes.com)>

**Cc:** David,Olaf <[Olaf.David@colostate.edu](mailto:Olaf.David@colostate.edu)>; Serafin,Francesco <[Francesco.Serafin@colostate.edu](mailto:Francesco.Serafin@colostate.edu)>; Venigalla, Vamsi <[VVenigalla@landolakes.com](mailto:VVenigalla@landolakes.com)>; Singh, Ruchi <[RSingh@landolakes.com](mailto:RSingh@landolakes.com)>; Mahesh Pusala <[mahesh.pusala@tavant.com](mailto:mahesh.pusala@tavant.com)>; Kostyanovsky, Kirill <[KKostyanovsky@landolakes.com](mailto:KKostyanovsky@landolakes.com)>; Duncan, Matthew <[mduncan01@landolakes.com](mailto:mduncan01@landolakes.com)>; Case,Shaun <[Shaun.Case@ColoState.EDU](mailto:Shaun.Case@ColoState.EDU)>; Killi, Ramana <[rkilli@landolakes.com](mailto:rkilli@landolakes.com)>

**Subject:** Re: Truterra - EFC Ssurgo data

Archit,

We can provide a csip-soils web service that returns the following data from the NRCS Soil Data Mart (SDM):

1. Organic matter, surface horizon (SDM parameter: om\_r): we will return this value  
Note: we can return an organic matter value as a weighted average to a specified depth, for example a root zone depth. Surface horizons vary in depth from a few centimeters to a meter or more.
2. Predominant soil: do you mean predominant mapunit, predominant soil component within predominant mapunit, or predominant soil component? We can return any of these.
3. Wind erodibility (wei): we will return this value (but currently not considered scientifically credible)
4. fips: is this the county or state code? We can return either.
5. Soil mapunit key (mukey): we will return this key
6. Hydrologic Group (hydgrp): we will return this value
7. K factor (kffact or kwfact): we will return this value

8. Soil Taxonomic Order (taxorder): we will return this value

Jack

On Jul 13, 2022, at 10:37 AM, Bhise, Archit <[ABhise@landolakes.com](mailto:ABhise@landolakes.com)> wrote:

**\*\* Caution: EXTERNAL Sender \*\***

Hello Jack,

Please find my response [in-line in blue](#) below.

I want to provide more context about my request –

Currently Truterra uses EFC-Ssurgo service for calculating KPIs and calculating Truterra Insights Score. These calculations are independent.

I understand that CSU will provide us KPIs calculated on the data sources mentioned in your comments below.

Following is a list of variables that Truterra Insights Score will need to compute scores on our side. We want to know if CSU can provide a service returning these variables at the soil mapunit level –

Soils Data received from EFC/SSURGO is as follows -	Use
om	Header
pct	used to determine predominant soil
wei	Header (I factor)
fips	KPI old
mukey	KPI old
slope	IS
hydgrp	IS
kffact	Header + Insights Score
yields	NUE
{	
crop	
year	
crop_id	
irryield	
nirryield":130.28	
}	
taxorder	Header + Insights Score (soil type)

Archit Bhise | Truterra Sustainability Tool BA | Land O'Lakes Inc.

C 707.290.4581 | [Abhise@landolakes.com](mailto:Abhise@landolakes.com)

<image001.png>

[www.truterraag.com](http://www.truterraag.com)



**From:** Carlson,Jack <[Jack.Carlson@colostate.edu](mailto:Jack.Carlson@colostate.edu)>

**Sent:** Tuesday, July 12, 2022 10:55 AM

**To:** Bhise, Archit <[ABhise@landolakes.com](mailto:ABhise@landolakes.com)>

**Cc:** David,Olaf <[Olaf.David@colostate.edu](mailto:Olaf.David@colostate.edu)>; Serafin,Francesco <[Francesco.Serafin@colostate.edu](mailto:Francesco.Serafin@colostate.edu)>; Venigalla, Vamsi <[VVenigalla@landolakes.com](mailto:VVenigalla@landolakes.com)>; Singh, Ruchi <[RSingh@landolakes.com](mailto:RSingh@landolakes.com)>; Mahesh Pusala <[mahesh.pusala@tavant.com](mailto:mahesh.pusala@tavant.com)>; Kostyanovsky, Kirill <[KKostyanovsky@landolakes.com](mailto:KKostyanovsky@landolakes.com)>; Duncan, Matthew <[mduncan01@landolakes.com](mailto:mduncan01@landolakes.com)>; Case,Shaun <[Shaun.Case@ColoState.EDU](mailto:Shaun.Case@ColoState.EDU)>

**Subject:** Re: Truterra - EFC Ssurgo data

Archit,

Some follow-up questions/comments:

1. A KPI farm field may intersect one to many soil mapunits. Each mapunit may have one to multiple soil components. Each soil component has a compct\_r (percentage) value. If a mapunit has more than one component, it is called a complex. Thus if a KPI field intersects three mapunits and each mapunit has two components, there are six soil components having an extent (intersected mapunit area \* compct\_r). From this list, a dominant soil component can be selected, the one with the greatest extent. Is this what you mean by predominant soil?

[We take existing data\(provided by EFC\) which contains maximum area for each soil within the field boundary. The soil having maximum area within the field is taken as predominant soil. What CSU is proposing above is more accurate, since mapunit may not equal soil series. We are open to using this approach. Truterra determines the predominant value based on the soil mapunits details received from ssurgo.](#)

2. We have several rules in place that mediate what is a surface soil horizon. Sometimes the top horizon is a Histosols (organic) and few/none of the soil parameters on your list are available to fetch. Thus we skip the horizon if it is less than 10 cm in depth, assuming it has been mixed by tillage with the next horizon. The rules are more elaborate than that, but is it okay to apply them to KPI? We recommend doing so. We do this for USDA.

[What is described by CSU is a more accurate way of doing this and TST will like to move towards this.](#)

3. The surface horizon K factor usually comes from the kffact parameter. Sometimes this parameter is null, but the kwfact is not. Current rule is to fetch the kffact, and lacking that then the kwfact.

[If we get kffact as null, we go back to the next predominant soil to fetch kffact; we do not consider kwfact. The CSU described behavior will be acceptable; can we understand the relation between kffact and kwfact?](#)

4. Water erosion models (RUSLE2 or WEPP) use the LightWeesies slope length rather than SSURGO slope length. The former is the maximum slope length for a slope steepness, the threshold at which concentrated flow (gully) erosion occurs on steep slope, or ponding occurs on flat slopes. Recommend

returning the LightleWeesies slope length unless there are other reasons for using the SSURGO value. Potential impact for Truterra is that TST Insights Score vulnerability scenario category for existing fields might change, however since the LightleWeesies slope is more field specific/ accurate we are open to using this instead of SSURGO.

5. SSURGO slope steepness (slope\_r) is a county scale average. Alternative method would be to use another web service returning a field-specific or intersected mapunit specific average slope based on 10-meter DEM.

6. USDA no longer considers the wei value to be scientifically credible. NRCS uses % sand (sandtotal\_r in SSURGO) as an indicator of wind erosion vulnerability. We also have a service that returns a wind erodibility index value from running WEPS on a tilled fallow management for the site in question. Takes ~15 seconds to complete. FSA is using it for CRP offer ranking purposes. However, the 15 seconds may exceed your response requirement. Run and cache might be an option.

Jack

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Jack R. Carlson  
Senior Research Associate  
Department of Civil and Environmental Engineering  
Colorado State University  
Fort Collins, Colorado

On Jul 11, 2022, at 3:00 PM, Bhise, Archit <[ABhise@landolakes.com](mailto:ABhise@landolakes.com)> wrote:

**\*\* Caution: EXTERNAL Sender \*\***

**\*\* Caution: EXTERNAL Sender \*\***

Hello Olaf,

I am Ramana's colleague from Truterra. Please find attached a sample response of Ssurgo data we receive from EFC and list of data elements.

From this we determine predominant soil based on most pct value in soils(taking that soil as predominant) and display below data in our application UI -

```
Soil : predominantsoil['muname']  
surfaceSoilCode:predominantsoil['texture']  
hydrologicSoilGroup:predominantsoil['hydgrpdc']  
kFactor:predominantsoil['kffact']
```

slopeLength:predominantsoil['slopegradwta']  
slopeGradDcp:predominantsoil['slopegraddcp']  
wei:predominantsoil['wei']  
taxOrder:predominantsoil['taxorder']  
organicMatterContent:predominantsoil['om']  
soilReport":efc\_surgo\_json\_reponse

Kindly let us know if your api/service provides the same data and if there is any processing performed on raw SSURGO data from your end.

Regards,

Archit Bhise | Truterra Sustainability Tool BA | Land O'Lakes Inc.

C 707.290.4581 | [Abhise@landolakes.com](mailto:Abhise@landolakes.com)



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<image001.png><EFC SSURGO response data points.xlsx><soilReport.json>

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