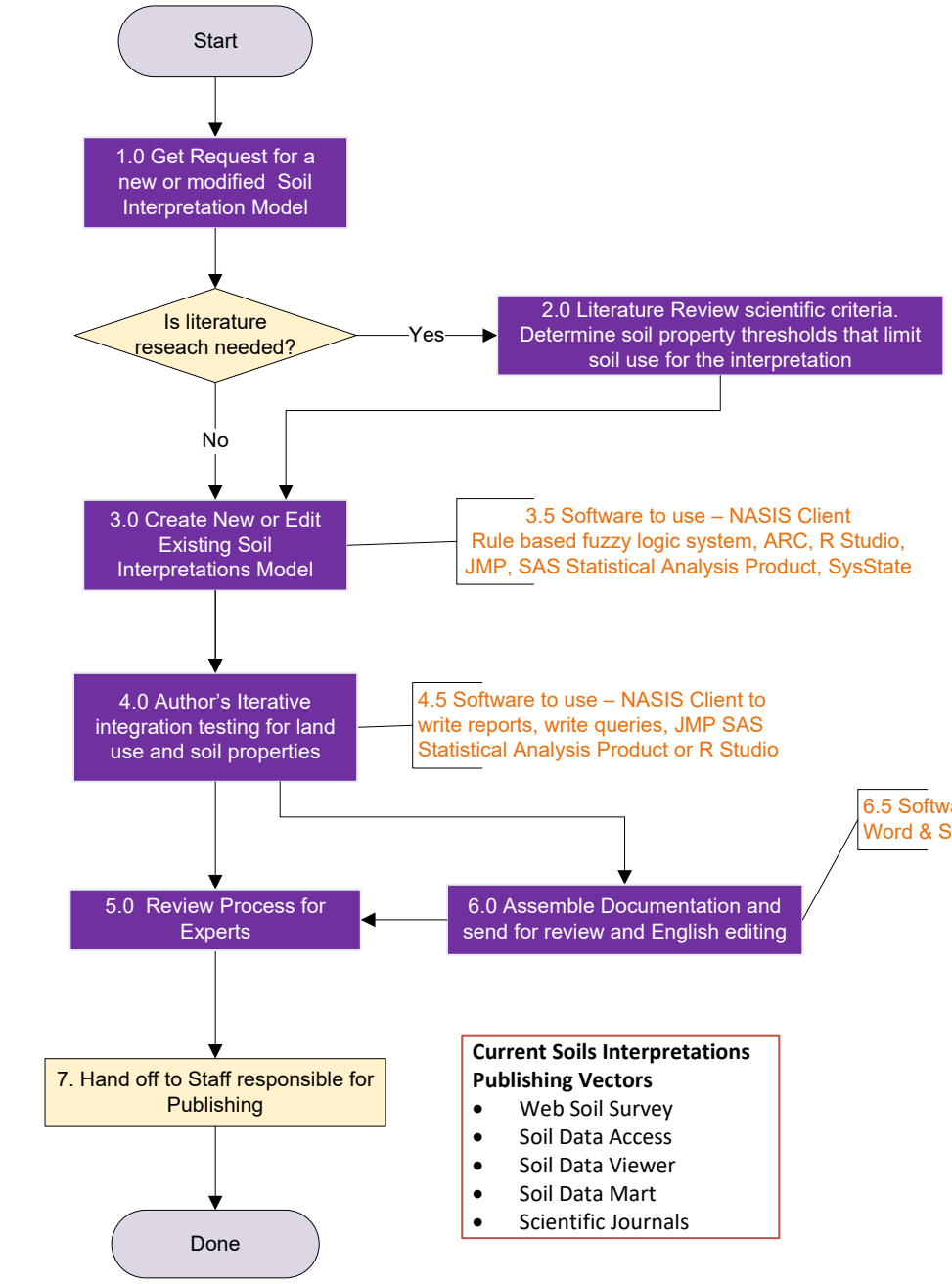
Soil Interpretation High Level Business Process V13 11/6/2020 DRAFT



Four types of Assigned Staff Creating Soil Interpretations
1. Science Team - researchers
2. Fuzzy Logic Modelers
3. Reviewers/Testers – verify that science and model work well
4. Documentation Team – detailed account of how interpretation works

Example Subject Matter Expert topics
- Agronomist
- Forester
- Engineer
- Hydrologist
- Biologist
- Soil Scientist
- infectious Disease Experts
- Range Specialists
- Conservation Planners

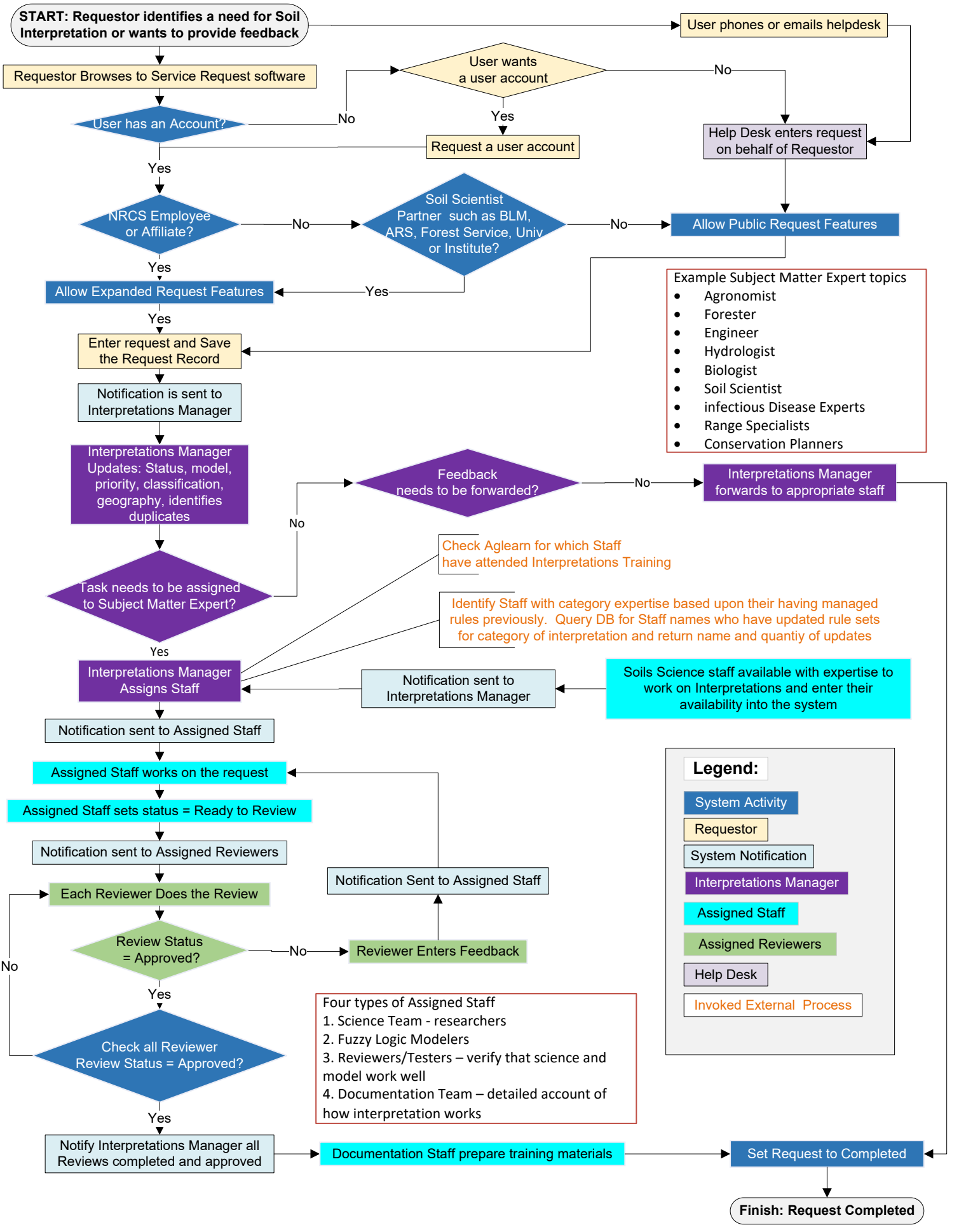
Current Soils Interpretations Publishing Vectors
- Web Soil Survey
- Soil Data Access
- Soil Data Viewer
- Soil Data Mart
- Scientific Journals

Legend:
- Manual Process
- Using Software
- New Software Needed
- Software used
- Go to another Diagram
- Start/End
- Note

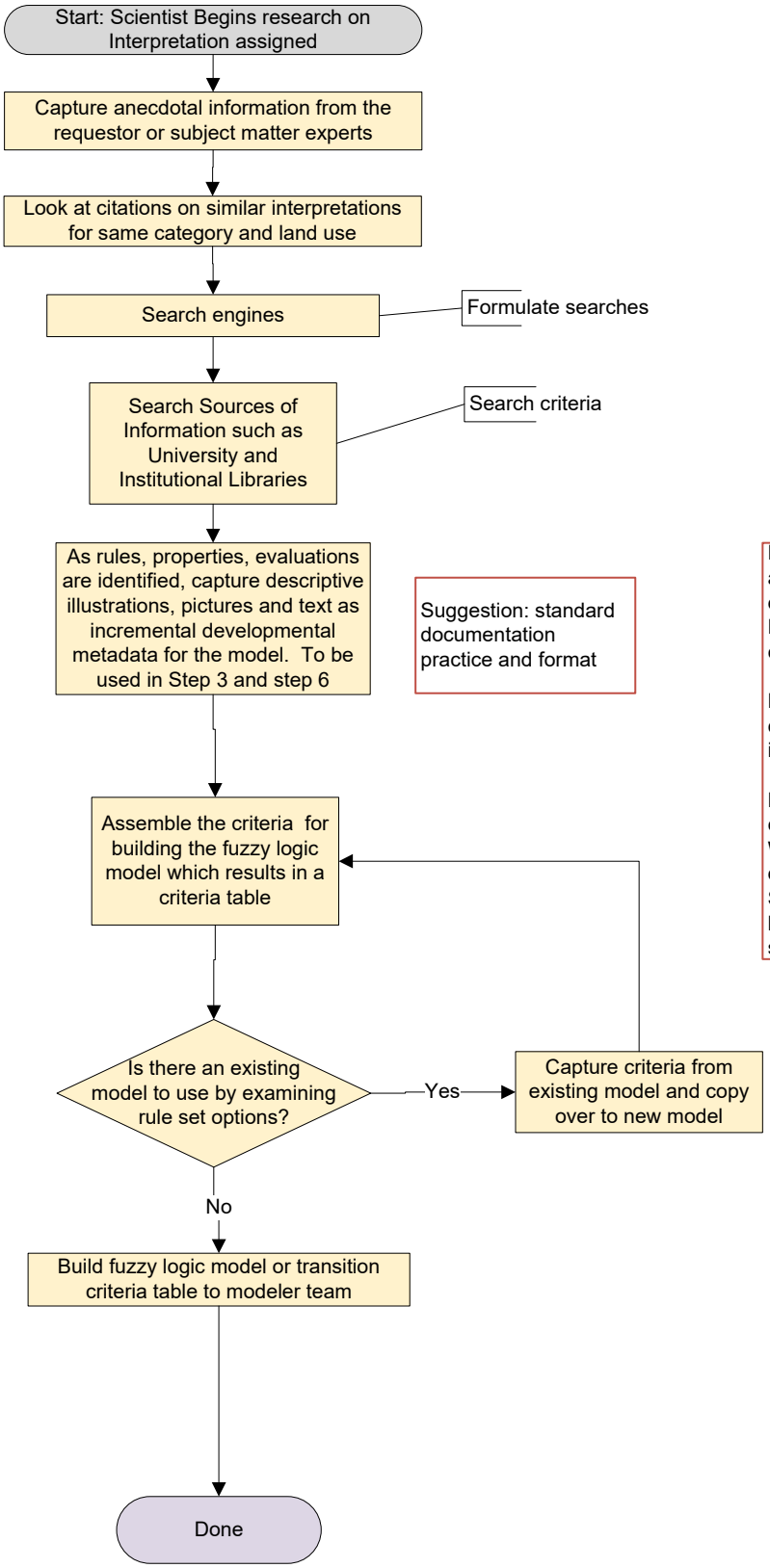
Future Goals:
- **Interpretations Generation to be easier to use for non-expert users**
- **Include more subject matter experts from different disciplines**
-

Future Process for Soil Interpretations Requests V6 10/28/2020 DRAFT

Current Process: White board list based on phone calls or email



2.0 Literature Review V7 10/19/2020 – Manual Process DRAFT



Example Subject Matter Expert topics

- Agronomist
- Forester
- Engineer
- Hydrologist
- Biologist
- Soil Scientist

Objective of Literature review:
Determine the thresholds for a soil property which are limiting to soil use.

- i.e. up til 5% slope is not a limiting factor (lower threshold).
- Upper threshold of slope that is limiting to agriculture would be over 25%. Could be 65% for forestry.
- Vertical cliff is infinite slope
- 100%, rise over run =1 (stairs are just under 100%).

Evaluations – membership function which comes out of fuzzy logic literature.- i.e. between Max/min or = optimum

- Rules, Evaluations and Properties
- Criteria and arguments
- Argument data

Need software support tools ' to be used as a place to capture criteria and thresholds and metadata to facilitate model creation and documentation, as well as justify the interpretation suitability results. Need the metadata and documentation to be accessible to external collaborators. For example GitHub or 'Protocols.IO

Need content manager: document results of literature review as criteria which can be reviewed by others prior to creating an interpretation.

Need Citation Management Software: Currently adding literature citations into NASIS descriptions (or future replacement for NASIS). When viewing the details of a model also need to be able to view and download pdf or other document formats attached/associated to the Soil Interpretations model. Each citation needs an identifier that can be used to create a link between the citation and multiple models or subsets of models.

Sources of Scientific Information

- University Staff
- Internal Subject Matter Experts
- Search Engines – search libraries, universities, Google Scholar, National Ag Library, AGRICOLA, wikipedia, Science Direct,
- Government Agencies such as USGS, RMA, US Army Corp of Engineers,
- University Extensions
- Publications

Legend:

- Manual Process
- Using Software
- New Software Needed
- Software used
- Go to another Diagram
- Start/End
- Note

Soil Interpretation Iterative Create Edit Process v9 11/6/2020 DRAFT

This is an example business flow option. The steps could be done in a different order.

3.0 Create New or Edit Soil Interpretations Model

Is this a new model

Yes

Create new Model by copying Existing as template?

No

Find the existing parent 'Primary' Rule to edit or copy.

Yes

Software to use – NASIS Client

Create New Model as copy?

No

Find parent Primary rule, find components that need editing, make changes to Rules, Properties, Evaluations as needed. Make a correction or add a feature/criteria/

Yes

Create New Primary Rules as Copy of existing Primary Rule

New UI – NASIS Client requires copy modify of each component separately and not as a set

Limitations of current NASIS client:

- Must first create copy of primary rule and then copy and attach each child. Need ability to copy the entire model.
- Lack of spatial analysis at these steps

For each Child rule, evaluation and property, use as is or create copy of current rule with new name and edit to meet new criteria

Software to use – NASIS Client
Rule based fuzzy logic system

Create A New Model

Begin Building the new components needed: Primary Parent Rule, subordinate rules, and properties with evaluation Membership Functions

ARC, Studio R, JMP, SAS Statistical Analysis Product, SysState

Create Property Scripts and Test them (property could be shared across interpretations)

Evaluate Candidate soils and site properties for relevance

Create one or more evaluations linked to parent property script

Create one membership function for each evaluation

Add evaluations into Rules or Group multiple evaluations into Rules. Use operators to define relationships (add, multiply, highest, lowest, average, etc)

Create new parent Primary Rule

Determine Test Input Data

Software to use – NASIS Client

Run the New or Corrected Soil Interpretation Model with Test Data

Request users fix the data

Yes

Is the underlying data incorrect?

No

Yes

yes

Is model working?

No

Is it fixed?

No

Is it a data problem?

No

More research?

Yes

yes

Create Scripts and Reports for Testing at State or County level (under 10,000 rows of data)

NASIS Client

Look for errors in the model, scripts, & rules, and make corrections. Run again

Go to: 2 Literature Review Step

No

Results ready Author Integrative Testing?

Go to 4.Author Integrative Test Process

Done

At each step changes made in the NASIS client are uploaded to NASIS DB where it is accessible to other internal users

Future Needs:

1. Ability to use more spatially explicit rasterized soils data and report interpretive results on a pixel basis.
2. Ability to draw from multiple authoritative databases (e.g. PRISM, NLCD, etc.)
3. Ability to link documentation when creating a property script or evaluation or rule
4. Ability to use conservation database, environmental data.
5. Need to be able to run an interpretive model using site specific data

Legend:

- Manual Process
- Using Software
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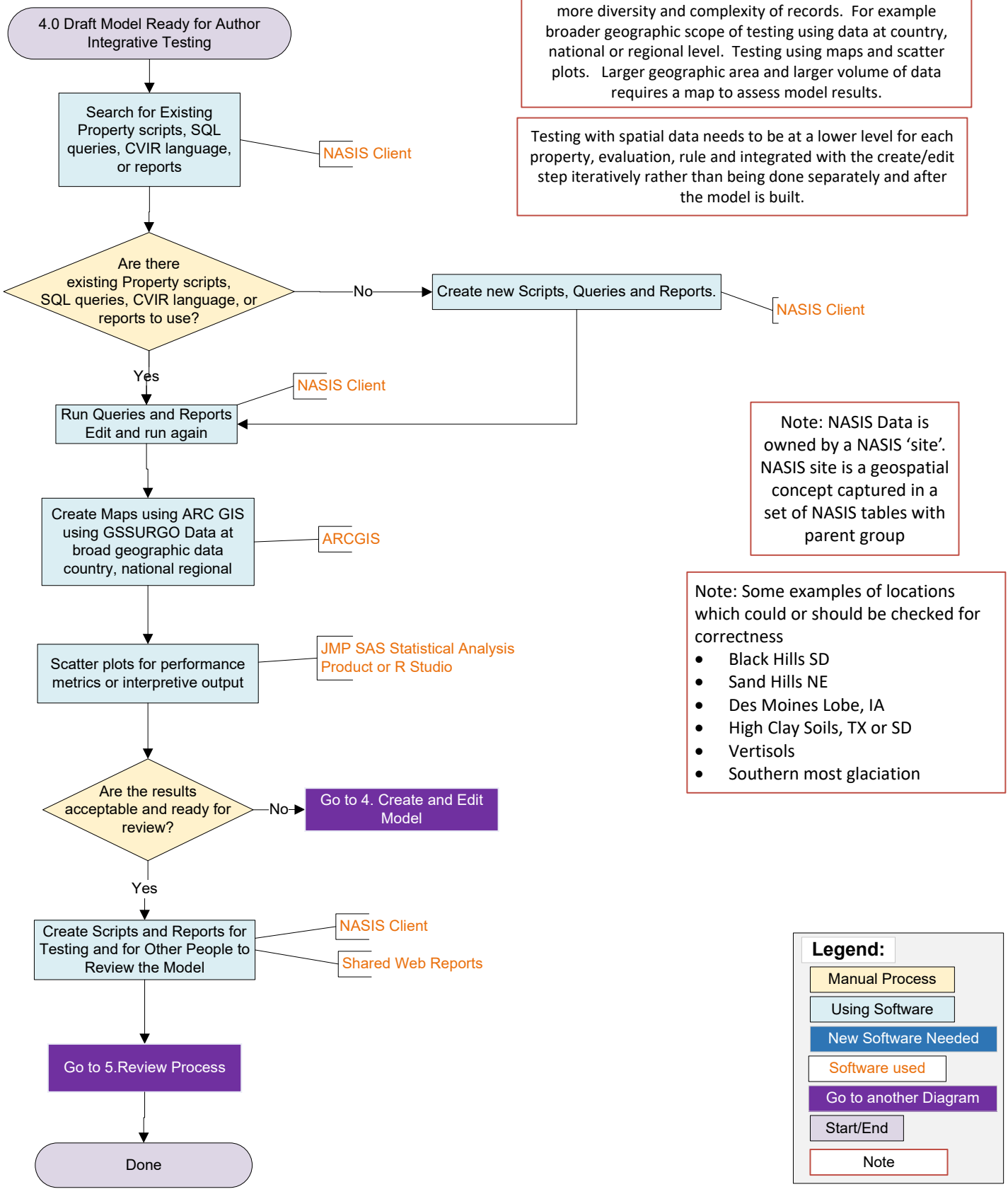
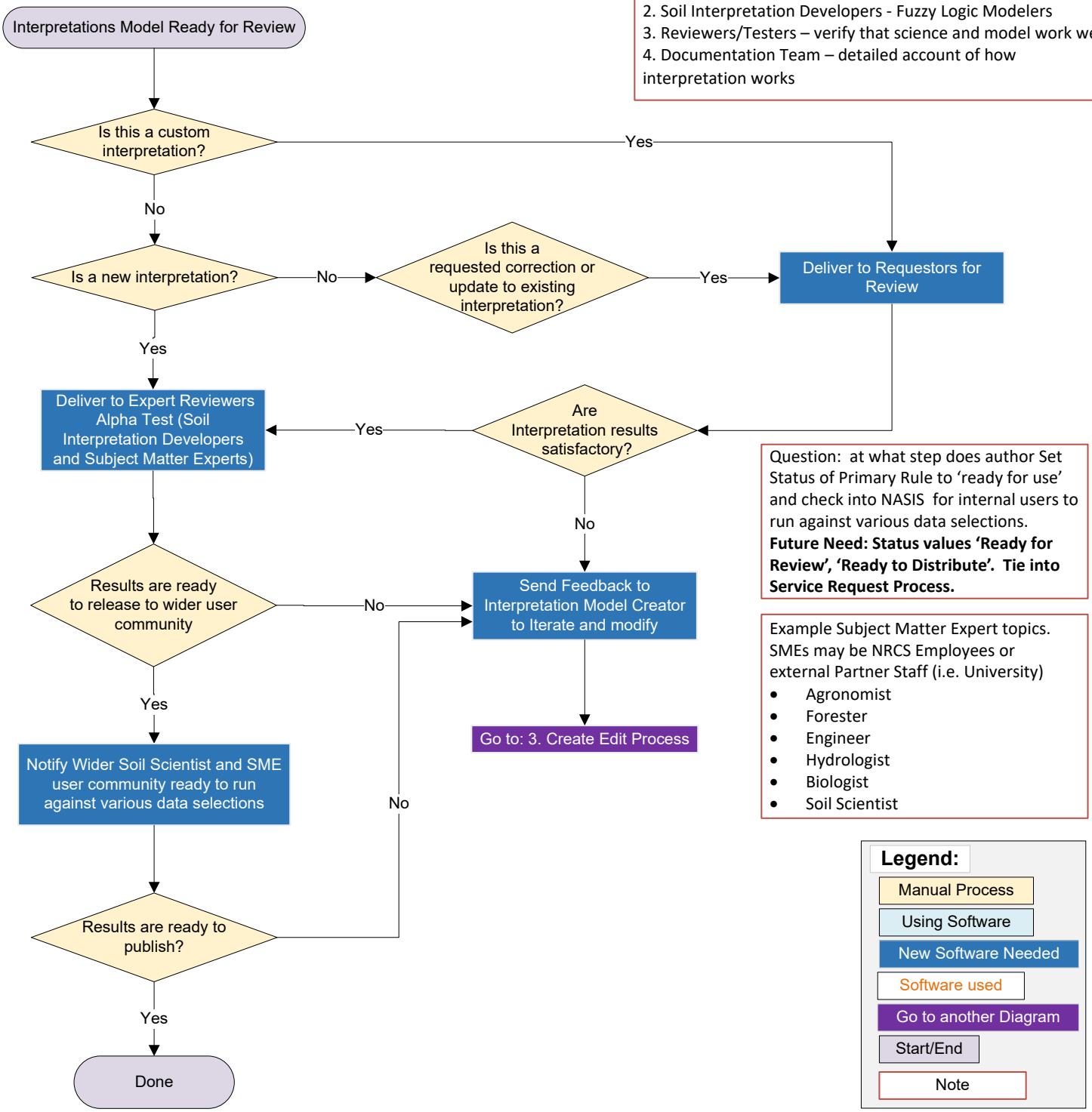
4.0 Author Integrative Test Process V8 11/6/2020 DRAFT



5. Soil Interpretation Review Process v4 11/6/2020 DRAFT



Four types of Assigned Staff
1. Science Team - researchers
2. Soil Interpretation Developers - Fuzzy Logic Modelers
3. Reviewers/Testers – verify that science and model work well
4. Documentation Team – detailed account of how interpretation works

Question: at what step does author Set Status of Primary Rule to 'ready for use' and check into NASIS for internal users to run against various data selections.
Future Need: Status values 'Ready for Review', 'Ready to Distribute'. Tie into Service Request Process.

Example Subject Matter Expert topics. SMEs may be NRCS Employees or external Partner Staff (i.e. University)

- Agronomist
- Forester
- Engineer
- Hydrologist
- Biologist
- Soil Scientist

Legend:

- Manual Process
- Using Software
- New Software Needed
- Software used
- Go to another Diagram
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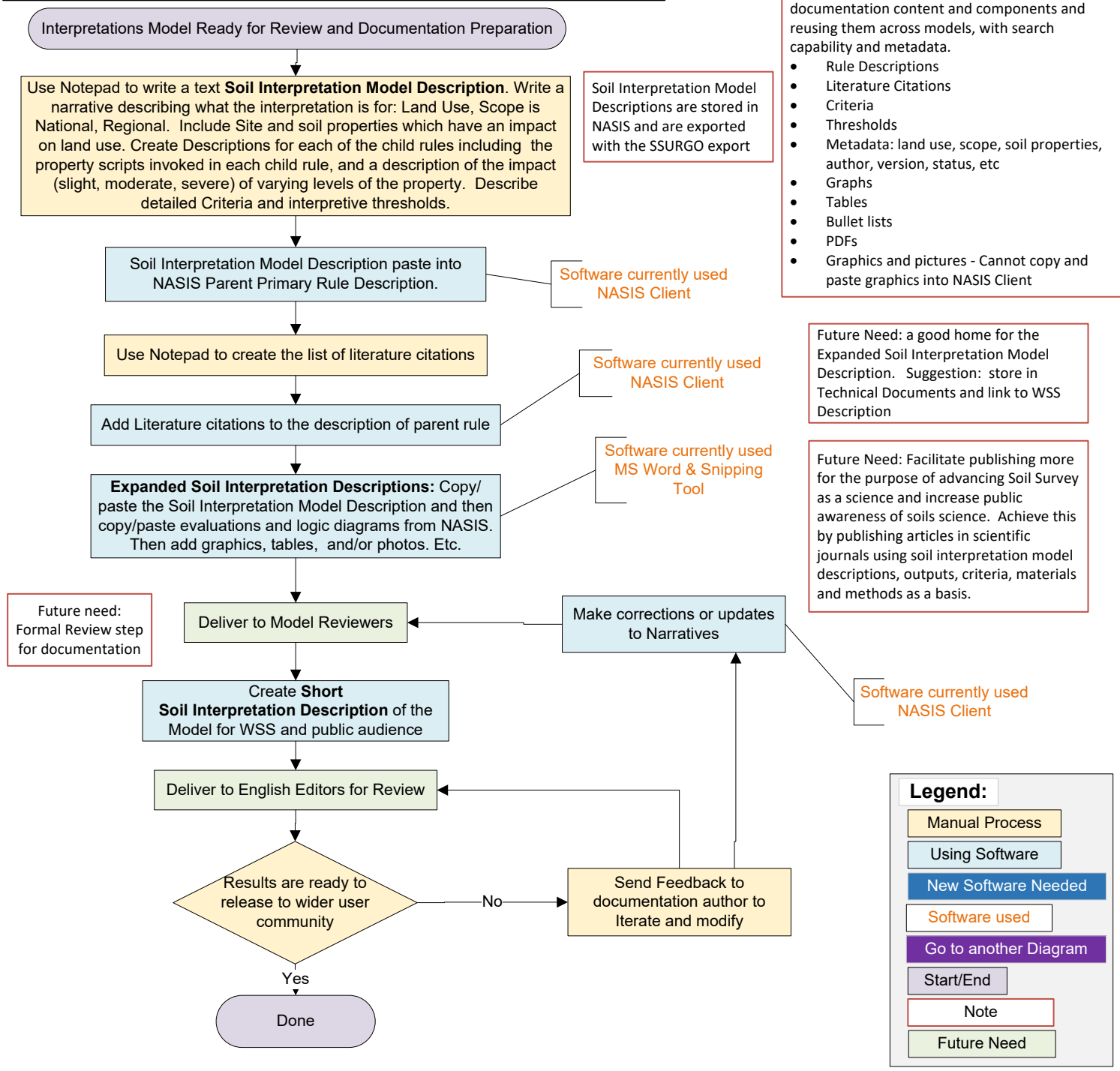
6. Assemble Documentation for a Soil Interpretation v4 11/6/2020 DRAFT



Current Rule Parent Relationships V5 11/6/2020 DRAFT

Soil Interpretations Model
Interpretation Model determines how appropriate soil at geographic locations are for a land use, soil use

Parent Rule (sub rule): assembly of base or sub rules. AKA **primary rule.** AKA primary interpretation. AKA Interpretation Model. Collection of related soil property rules. Rule that is published on WSS
Examples:

1. National commodity crop index - four rules that deal with crops. Report outputs of parent crop rules as parents.

Sub rule where the button 'primary interpretation' is checked. Graphical editor doesn't show the hierarchy.

Property Scripts – obtains the input data, passes to the Evaluation

Larger Sub Rule – assembly of base rules. Collection of related soil propety rules. Use in several applications
Examples:
1. Set of crop land rules
--pH subrule
- slope sub rule
-Stone size sub
2. sub rules for rangeland
3. Animal feed crops
4. orchard
5. rules for geographic area

Base Rule – effect of one soil property. Building block to parent rule. May or may not be specific to a land use, Crop/specific crop, Rangeland/type?.
Lowest level. Tied to one evaluation.
1. Crop pH
2. slope – engineering, but also for crop
(UI sub rule that is a child of another sub rule)

Evaluation Membership Function i.e. pH Evaluation – runs the rules against the input data, assigns a membership value and passes the fuzzy number evaluation to the sub rule to determine what the evaluation means for the land use whether it is a limiting factor

Sub Rule – assembly of base rules. Collection of related soil property rules.
Examples:
1. Sizes of stones. Level of impact from different stone size. Boulder, cobble, gravel, etc.
2. Properties of slope -
3. Properties of pH – too acid, too alkaline, normal for crop
4. Electrical conductivity
5. Salinity
5. Aluminum tolerance

Note for Cathy
Future: ability to select a modeling system other than fuzzy logic such as neural net, ?. Current: limited to fuzzy logic model

Primary interpretation (i.e.) crop) (stored as sub rule that has primary interpretation attribute)

Sub interpretation
One for soybeans, one for corn, … (stored as sub rule that has primary interpretation attribute)

Rules (sub rules, base rules, larger sub rules)

Example Rule Relationships V6 11/6/2020 DRAFT

Soil Interpretations Model
Interpretation Model determines how appropriate soil at geographic locations are for a land use, soil use

Model Crop Corn (Parent Rule (sub rule): assembly of base or sub rules. AKA **primary rule.** AKA primary interpretation. AKA Interpretation Model. Collection of related soil property rules. Rule that is published on WSS
Examples:
1. National commodity crop index - four rules that deal with crops. Report outputs of parent crop rules as parents.
Sub rule where the button 'primary interpretation' is checked. Graphical editor doesn't show the hierarchy.

Model Crop soybeans (Parent Rule (sub rule): assembly of base or sub rules. AKA **primary rule.** AKA primary interpretation. AKA Interpretation Model. Collection of related soil property rules. Rule that is published on WSS
Examples:
1. National commodity crop index - four rules that deal with crops. Report outputs of parent crop rules as parents.
Sub rule where the button 'primary interpretation' is checked. Graphical editor doesn't show the hierarchy.

Module R (Larger Sub Rule) – assembly of base rules. Collection of related soil propety rules. Use in several applications
Examples:
1. Set of crop land rules
- pH subrule
- slope sub rule
- Stone size sub
2. sub rules for rangeland
3. Animal feed crops
4. orchard
5. rules for geographic area

Module S (Larger Sub Rule) – assembly of base rules. Collection of related soil propety rules. Use in several applications
Examples:
1. Set of crop land rules
- pH sub rule
- slope sub rule
- Stone size sub
2. sub rules for rangeland
3. Animal feed crops
4. orchard
5. rules for geographic area

Collection A (Sub Rule) – assembly of base rules. Collection of related soil property rules.
Examples:
1. Sizes of stones. Level of impact from different stone size. Boulder, cobble, gravel, etc.
2. Properties of slope -
3. Properties of pH – too acid, too alkaline, normal for crop
4. Electrical conductivity
5. Salinity
5. Aluminum tolerance

Collection B (Sub Rule) – assembly of base rules. Collection of related soil property rules.
Examples:
1. Sizes of stones. Level of impact from different stone size. Boulder, cobble, gravel, etc.
2. Properties of slope -
3. Properties of pH – too acid, too alkaline, normal for crop
4. Electrical conductivity
5. Salinity
5. Aluminum tolerance

Base Rule X – effect of one soil property. Building block to parent rule. May or may not be specific to a land use, Crop/specific crop, Rangeland/type?.
Lowest level. Tied to one evaluation.
1. Crop pH
2. slope – engineering, but also for crop
(UI sub rule that is a child of another sub rule)

Rule relationships: Operators (plus/ minus, division, multiply and, for, min, max_, hedges (20-30,),

Hedges and operators can be used between evaluations, and rules. Result coming from evaluations needs to be hedged before being input to rule. Example, evaluation result is null and needs to be

Note for Cathy
Future: ability to select a modeling system other than fuzzy logic such as neural net, ?. Current: limited to fuzzy logic model

Evaluation Membership Function
i.e. pH Evaluation – runs the rules against the input data, assigns a membership value and passes the fuzzy number evaluation to the sub rule to determine what the evaluation means for the land use whether it is a limiting factor

Property Scripts – obtains the input data, passes to the Evaluation

Primary interpretation (i.e.) crop) (stored as sub rule that has primary interpretation attribute)

Sub interpretation
One for soybeans, one for corn, … (stored as sub rule that has primary interpretation attribute)

Rules (sub rules, base rules, larger sub rules)

Current Interpretations Data Flow V2 11/6/2020