Green_Infrastructure_with_Workflows

January 24, 2017

0.1 Here, the Garden Infrastructure Designer web site is loaded for users to create custom GI.

In [1]:
```
%%HTML
<iframe id="myiframe" width="1000px" height="900px" src="http://gidesigner.

<script type="text/javascript">

var eventMethod = window.addEventListener;
var eventer = window[eventMethod];
var messageEvent = "message";

window.addEventListener('message',function(e) {
    var key = e.message ? 'message' : 'data';
    if(key == "data")
    {
        var data = e[key];
        var res = data.split("=");
        var new_key = res[0];
        var new_value = res[1];
        console.log(new_key);
        if(new_key.includes("download_url") )
        {
            IPython.notebook.kernel.execute(new_key + '=\'' + new_value + '
            console.log(new_value);
        }
        else
        {
            var json = JSON.parse(new_value);
            var json_string = JSON.stringify(json);
            console.log(json_string);
            IPython.notebook.kernel.execute(new_key + '=\'' + json_string +
        }
    };
},false);
</script>
```

```
<IPython.core.display.HTML object>
```

0.2 The steps below assume you have created a new soil and landcover GI design.

0.2.1 To access the Landcover Dataset

```
In [3]: print(landuse_download_url);
        !wget $landuse_download_url
```

```
http://hydroterre.psu.edu/GI_RHESSys/j1496d9abac494672bdf729b1734d89db/scratch/GI_L
--2017-01-24 14:54:38--  http://hydroterre.psu.edu/GI_RHESSys/j1496d9abac494672bdf7
Resolving hydroterre.psu.edu (hydroterre.psu.edu)... 192.5.158.22
Connecting to hydroterre.psu.edu (hydroterre.psu.edu)|192.5.158.22|:80... connected
HTTP request sent, awaiting response... 200 OK
Length: 78581 (77K) [application/x-zip-compressed]
Saving to: 'GI_Landuse.zip.4'

GI_Landuse.zip.4    100%[====================>]  76.74K   471KB/s   in 0.2s

2017-01-24 14:54:40 (471 KB/s) - 'GI_Landuse.zip.4' saved [78581/78581]
```

0.2.2 To access the Soil Dataset

```
In [4]: print(soil_download_url);
        !wget $soil_download_url
```

```
http://hydroterre.psu.edu/GI_RHESSys_SoilOnly/j891d6c150f8140d0a5299a2db7eaee19/scr
--2017-01-24 14:54:40--  http://hydroterre.psu.edu/GI_RHESSys_SoilOnly/j891d6c150f8
Resolving hydroterre.psu.edu (hydroterre.psu.edu)... 192.5.158.22
Connecting to hydroterre.psu.edu (hydroterre.psu.edu)|192.5.158.22|:80... connected
HTTP request sent, awaiting response... 200 OK
Length: 24094 (24K) [application/x-zip-compressed]
Saving to: 'GI_Soil.zip.1'

GI_Soil.zip.1       100%[====================>]  23.53K  --.-KB/s   in 0.08s

2017-01-24 14:54:41 (284 KB/s) - 'GI_Soil.zip.1' saved [24094/24094]
```

0.3 To access GI geometry and Custom GI definitions

After creating GI under the **Save or Load GI tab** there are two ways to access the data for RHESSys workflows. As before, files can be downloaded and uploaded to HydroShare as a resource. Here, the second method is demonstrated using global variables. Below, shows the steps to access these variables after clicking on the **Save GI variables to HydroShare** button.

0.3.1 To access Polygon Marker Geometry (i.e. soils, surfaces)

Use the variable **hs_polygon_markers**

```
In [6]: import json
        from collections import OrderedDict
        data = json.loads(hs_polygon_markers, object_pairs_hook=OrderedDict)
        print(json.dumps(data, indent=4));
```


```
{
    "3": {
        "current_surface_type": 0,
        "id": 3,
        "area": "37.88",
        "landuse_value": "1",
        "surfaceID": "SurfaceA",
        "visible": true,
        "latLngs": [
            {
                "lat": 39.29379783510224,
                "lng": -76.74443319439888
            },
            {
                "lat": 39.29376566042623,
                "lng": -76.74455255270004
            },
            {
                "lat": 39.29373971309609,
                "lng": -76.74449220299721
            },
            {
                "lat": 39.29376254674711,
                "lng": -76.7444197833538
            }
        ]
    },
    "4": {
        "current_surface_type": 1,
        "id": 4,
        "area": "52.66",
        "landuse_value": "1",
        "surfaceID": "SurfaceA",
        "visible": true,
        "latLngs": [
            {
                "lat": 39.293815998219294,
                "lng": -76.74441508948803
            },
            {
                "lat": 39.29381392243471,
                "lng": -76.744499579072
            },
```

```
            {
                "lat": 39.29373608046912,
                "lng": -76.74445062875748
            },
            {
                "lat": 39.293753724655545,
                "lng": -76.74438893795013
            }
        ]
    }
}
```

0.3.2 To access Point Marker Geometry (i.e. Tree locations)

Use the variable **hs_point_markers**

```
In [7]: import json
        from collections import OrderedDict
        data = json.loads(hs_point_markers, object_pairs_hook=OrderedDict)
        print(json.dumps(data, indent=4));
```

```
{
    "1": {
        "current_surface_type": -1,
        "icon": "icons/tree1_icon_medium.png",
        "id": 1,
        "stratum_value": "2",
        "title": "Drag me!",
        "treeID": "TreeA_sizeM",
        "tree_radius": "2",
        "visible": true,
        "lat": 39.29379991088728,
        "lng": -76.74451500177383
    },
    "2": {
        "current_surface_type": -1,
        "icon": "icons/tree1_icon_medium.png",
        "id": 2,
        "stratum_value": "2",
        "title": "Drag me!",
        "treeID": "TreeA_sizeM",
        "tree_radius": "2",
        "visible": true,
        "lat": 39.29378434249798,
        "lng": -76.74457669258118
    }
}
```

0.3.3 To access GI Tree Properties

Use the variable **hs_tree_dictionary**

```
In [8]: import json
        from collections import OrderedDict
        data = json.loads(hs_tree_dictionary, object_pairs_hook=OrderedDict)
        print(json.dumps(data, indent=4));
```


```
{
    "TreeA_sizeL": {
        "type": "TreeA",
        "size": "L",
        "pretty_name": "Maple",
        "radius": "4",
        "landuse": "2",
        "cost": "500",
        "labor_cost": "750"
    },
    "TreeA_sizeM": {
        "type": "TreeA",
        "size": "M",
        "pretty_name": "Maple",
        "radius": "2",
        "landuse": "2",
        "cost": "150",
        "labor_cost": "500"
    },
    "TreeA_sizeS": {
        "type": "TreeA",
        "size": "S",
        "pretty_name": "Maple",
        "radius": "1",
        "landuse": "2",
        "cost": "50",
        "labor_cost": "150"
    },
    "TreeB_sizeL": {
        "type": "TreeB",
        "size": "L",
        "pretty_name": "Sweetgum",
        "radius": "4",
        "landuse": "2",
        "cost": "500",
        "labor_cost": "750"
    },
    "TreeB_sizeM": {
        "type": "TreeB",
        "size": "M",
```

```
    "pretty_name": "Sweetgum",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeB_sizeS": {
    "type": "TreeB",
    "size": "S",
    "pretty_name": "Sweetgum",
    "radius": "1",
    "landuse": "2",
    "cost": "50",
    "labor_cost": "150"
},
"TreeC_sizeL": {
    "type": "TreeC",
    "size": "L",
    "pretty_name": "Lodgepole pine",
    "radius": "4",
    "landuse": "2",
    "cost": "500",
    "labor_cost": "750"
},
"TreeC_sizeM": {
    "type": "TreeC",
    "size": "M",
    "pretty_name": "Lodgepole pine",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeC_sizeS": {
    "type": "TreeC",
    "size": "S",
    "pretty_name": "Lodgepole pine",
    "radius": "1",
    "landuse": "2",
    "cost": "50",
    "labor_cost": "150"
},
"TreeD_sizeL": {
    "type": "TreeD",
    "size": "L",
    "pretty_name": "Flowering dogwood",
    "radius": "4",
    "landuse": "2",
```

```
    "cost": "500",
    "labor_cost": "750"
},
"TreeD_sizeM": {
    "type": "TreeD",
    "size": "M",
    "pretty_name": "Flowering dogwood",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeD_sizeS": {
    "type": "TreeD",
    "size": "S",
    "pretty_name": "Flowering dogwood",
    "radius": "1",
    "landuse": "2",
    "cost": "50",
    "labor_cost": "150"
},
"TreeE_sizeL": {
    "type": "TreeE",
    "size": "L",
    "pretty_name": "Sugar maple",
    "radius": "4",
    "landuse": "2",
    "cost": "500",
    "labor_cost": "750"
},
"TreeE_sizeM": {
    "type": "TreeE",
    "size": "M",
    "pretty_name": "Sugar maple",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeE_sizeS": {
    "type": "TreeE",
    "size": "S",
    "pretty_name": "Sugar maple",
    "radius": "1",
    "landuse": "2",
    "cost": "50",
    "labor_cost": "150"
},
```

```
"TreeF_sizeL": {
    "type": "TreeF",
    "size": "L",
    "pretty_name": "Quaking aspen",
    "radius": "4",
    "landuse": "2",
    "cost": "500",
    "labor_cost": "750"
},
"TreeF_sizeM": {
    "type": "TreeF",
    "size": "M",
    "pretty_name": "Quaking aspen",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeF_sizeS": {
    "type": "TreeF",
    "size": "S",
    "pretty_name": "Quaking aspen",
    "radius": "1",
    "landuse": "2",
    "cost": "50",
    "labor_cost": "150"
},
"TreeG_sizeL": {
    "type": "TreeG",
    "size": "L",
    "pretty_name": "Douglas-fir",
    "radius": "4",
    "landuse": "2",
    "cost": "500",
    "labor_cost": "750"
},
"TreeG_sizeM": {
    "type": "TreeG",
    "size": "M",
    "pretty_name": "Douglas-fir",
    "radius": "2",
    "landuse": "2",
    "cost": "150",
    "labor_cost": "500"
},
"TreeG_sizeS": {
    "type": "TreeG",
    "size": "S",
```

```
        "pretty_name": "Douglas-fir",
        "radius": "1",
        "landuse": "2",
        "cost": "50",
        "labor_cost": "150"
    }
}
```

0.3.4 To access GI Stratum Properties

Use the variable **hs_stratum_dictionary**

```
In [9]: import json
        from collections import OrderedDict
        data = json.loads(hs_stratum_dictionary, object_pairs_hook=OrderedDict)
        print(json.dumps(data, indent=4));
```

```
{
    "SurfaceA_depth_sizeL": {
        "surface_name": "SurfaceA",
        "pretty_name": "Evergreen",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "1",
        "cost": "2",
        "labor_cost": "4"
    },
    "SurfaceA_depth_sizeM": {
        "surface_name": "SurfaceA",
        "pretty_name": "Evergreen",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "1",
        "cost": "2",
        "labor_cost": "3"
    },
    "SurfaceA_depth_sizeS": {
        "surface_name": "SurfaceA",
        "pretty_name": "Evergreen",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "1",
        "cost": "2",
        "labor_cost": "2"
    },
    "SurfaceB_depth_sizeL": {
        "surface_name": "SurfaceB",
```

```
    "pretty_name": "Eucalypt",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "4"
},
"SurfaceB_depth_sizeM": {
    "surface_name": "SurfaceB",
    "pretty_name": "Eucalypt",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "3"
},
"SurfaceB_depth_sizeS": {
    "surface_name": "SurfaceB",
    "pretty_name": "Eucalypt",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "2"
},
"SurfaceC_depth_sizeL": {
    "surface_name": "SurfaceC",
    "pretty_name": "Deciduous",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "2",
    "cost": "2",
    "labor_cost": "4"
},
"SurfaceC_depth_sizeM": {
    "surface_name": "SurfaceC",
    "pretty_name": "Deciduous",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "2",
    "cost": "2",
    "labor_cost": "3"
},
"SurfaceC_depth_sizeS": {
    "surface_name": "SurfaceC",
    "pretty_name": "Deciduous",
    "depth_size": "S",
    "depth_value": "0.25",
```

```
        "landuse": "2",
        "cost": "2",
        "labor_cost": "2"
    },
    "SurfaceD_depth_sizeL": {
        "surface_name": "SurfaceD",
        "pretty_name": "Deciduous_BES",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "21",
        "cost": "2",
        "labor_cost": "4"
    },
    "SurfaceD_depth_sizeM": {
        "surface_name": "SurfaceD",
        "pretty_name": "Deciduous_BES",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "21",
        "cost": "2",
        "labor_cost": "3"
    },
    "SurfaceD_depth_sizeS": {
        "surface_name": "SurfaceD",
        "pretty_name": "Deciduous_BES",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "21",
        "cost": "2",
        "labor_cost": "2"
    },
    "SurfaceE_depth_sizeL": {
        "surface_name": "SurfaceE",
        "pretty_name": "Grass",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "3",
        "cost": "2",
        "labor_cost": "4"
    },
    "SurfaceE_depth_sizeM": {
        "surface_name": "SurfaceE",
        "pretty_name": "Grass",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "3",
        "cost": "2",
        "labor_cost": "3"
```

```
},
"SurfaceE_depth_sizeS": {
    "surface_name": "SurfaceE",
    "pretty_name": "Grass",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "3",
    "cost": "2",
    "labor_cost": "2"
},
"SurfaceF_depth_sizeL": {
    "surface_name": "SurfaceF",
    "pretty_name": "Lawn_10cm",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "31",
    "cost": "2",
    "labor_cost": "4"
},
"SurfaceF_depth_sizeM": {
    "surface_name": "SurfaceF",
    "pretty_name": "Lawn_10cm",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "31",
    "cost": "2",
    "labor_cost": "3"
},
"SurfaceF_depth_sizeS": {
    "surface_name": "SurfaceF",
    "pretty_name": "Lawn_10cm",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "31",
    "cost": "2",
    "labor_cost": "2"
},
"SurfaceG_depth_sizeL": {
    "surface_name": "SurfaceG",
    "pretty_name": "Lawn_5cm",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "32",
    "cost": "2",
    "labor_cost": "4"
},
"SurfaceG_depth_sizeM": {
    "surface_name": "SurfaceG",
```

```
        "pretty_name": "Lawn_5cm",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "32",
        "cost": "2",
        "labor_cost": "3"
    },
    "SurfaceG_depth_sizeS": {
        "surface_name": "SurfaceG",
        "pretty_name": "Lawn_5cm",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "32",
        "cost": "2",
        "labor_cost": "2"
    },
    "SurfaceH_depth_sizeL": {
        "surface_name": "SurfaceH",
        "pretty_name": "Lawn_2cm",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "33",
        "cost": "2",
        "labor_cost": "4"
    },
    "SurfaceH_depth_sizeM": {
        "surface_name": "SurfaceH",
        "pretty_name": "Lawn_2cm",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "33",
        "cost": "2",
        "labor_cost": "3"
    },
    "SurfaceH_depth_sizeS": {
        "surface_name": "SurfaceH",
        "pretty_name": "Lawn_2cm",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "33",
        "cost": "2",
        "labor_cost": "2"
    },
    "SurfaceI_depth_sizeL": {
        "surface_name": "SurfaceI",
        "pretty_name": "NonVeg",
        "depth_size": "L",
        "depth_value": "1.0",
```

```
        "landuse": "4",
        "cost": "2",
        "labor_cost": "4"
    },
    "SurfaceI_depth_sizeM": {
        "surface_name": "SurfaceI",
        "pretty_name": "NonVeg",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "4",
        "cost": "2",
        "labor_cost": "3"
    },
    "SurfaceI_depth_sizeS": {
        "surface_name": "SurfaceI",
        "pretty_name": "NonVeg",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "4",
        "cost": "2",
        "labor_cost": "2"
    }
}
```


0.3.5 To access GI Soil Properties

Use the variable **hs_soil_dictionary**

```
In [13]: import json
         from collections import OrderedDict
         data = json.loads(hs_soil_dictionary, object_pairs_hook=OrderedDict)
         print(json.dumps(data, indent=4));
```


```
{
    "SoilA_depth_sizeL": {
        "surface_name": "SoilA",
        "pretty_name": "Clay",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "1",
        "cost": "2",
        "labor_cost": "4"
    },
    "SoilA_depth_sizeM": {
        "surface_name": "SoilA",
        "pretty_name": "Clay",
        "depth_size": "M",
```

```
    "depth_value": "0.5",
    "landuse": "1",
    "cost": "2",
    "labor_cost": "3"
},
"SoilA_depth_sizeS": {
    "surface_name": "SoilA",
    "pretty_name": "Clay",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "1",
    "cost": "2",
    "labor_cost": "2"
},
"SoilB_depth_sizeL": {
    "surface_name": "SoilB",
    "pretty_name": "Silt-Clay",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "2",
    "cost": "2",
    "labor_cost": "4"
},
"SoilB_depth_sizeM": {
    "surface_name": "SoilB",
    "pretty_name": "Silt-Clay",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "2",
    "cost": "2",
    "labor_cost": "3"
},
"SoilB_depth_sizeS": {
    "surface_name": "SoilB",
    "pretty_name": "Silt-Clay",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "2",
    "cost": "2",
    "labor_cost": "2"
},
"SoilC_depth_sizeL": {
    "surface_name": "SoilC",
    "pretty_name": "Silty-Clay-Loam",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "3",
    "cost": "2",
```

```
    "labor_cost": "4"
},
"SoilC_depth_sizeM": {
    "surface_name": "SoilC",
    "pretty_name": "Silty-Clay-Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "3",
    "cost": "2",
    "labor_cost": "3"
},
"SoilC_depth_sizeS": {
    "surface_name": "SoilC",
    "pretty_name": "Silty-Clay-Loam",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "3",
    "cost": "2",
    "labor_cost": "2"
},
"SoilD_depth_sizeL": {
    "surface_name": "SoilD",
    "pretty_name": "Sandy-Clay",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "4",
    "cost": "2",
    "labor_cost": "4"
},
"SoilD_depth_sizeM": {
    "surface_name": "SoilD",
    "pretty_name": "Sandy-Clay",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "4",
    "cost": "2",
    "labor_cost": "3"
},
"SoilD_depth_sizeS": {
    "surface_name": "SoilD",
    "pretty_name": "Sandy-Clay",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "4",
    "cost": "2",
    "labor_cost": "2"
},
"SoilE_depth_sizeL": {
```

```
    "surface_name": "SoilE",
    "pretty_name": "Sandy-Clay-Loam",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "5",
    "cost": "2",
    "labor_cost": "4"
},
"SoilE_depth_sizeM": {
    "surface_name": "SoilE",
    "pretty_name": "Sandy-Clay-Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "5",
    "cost": "2",
    "labor_cost": "3"
},
"SoilE_depth_sizeS": {
    "surface_name": "SoilE",
    "pretty_name": "Sandy-Clay-Loam",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "5",
    "cost": "2",
    "labor_cost": "2"
},
"SoilF_depth_sizeL": {
    "surface_name": "SoilF",
    "pretty_name": "Clay-Loam",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "6",
    "cost": "2",
    "labor_cost": "4"
},
"SoilF_depth_sizeM": {
    "surface_name": "SoilF",
    "pretty_name": "Clay-Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "6",
    "cost": "2",
    "labor_cost": "3"
},
"SoilF_depth_sizeS": {
    "surface_name": "SoilF",
    "pretty_name": "Clay-Loam",
    "depth_size": "S",
```

```
    "depth_value": "0.25",
    "landuse": "6",
    "cost": "2",
    "labor_cost": "2"
},
"SoilG_depth_sizeL": {
    "surface_name": "SoilG",
    "pretty_name": "Silt",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "7",
    "cost": "2",
    "labor_cost": "4"
},
"SoilG_depth_sizeM": {
    "surface_name": "SoilG",
    "pretty_name": "Silt",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "7",
    "cost": "2",
    "labor_cost": "3"
},
"SoilG_depth_sizeS": {
    "surface_name": "SoilG",
    "pretty_name": "Silt",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "7",
    "cost": "2",
    "labor_cost": "2"
},
"SoilH_depth_sizeL": {
    "surface_name": "SoilH",
    "pretty_name": "Silt-Loam",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "8",
    "cost": "2",
    "labor_cost": "4"
},
"SoilH_depth_sizeM": {
    "surface_name": "SoilH",
    "pretty_name": "Silt-Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "8",
    "cost": "2",
```

```
    "labor_cost": "3"
},
"SoilH_depth_sizeS": {
    "surface_name": "SoilH",
    "pretty_name": "Silt-Loam",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "8",
    "cost": "2",
    "labor_cost": "2"
},
"SoilI_depth_sizeL": {
    "surface_name": "SoilI",
    "pretty_name": "Loam",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "9",
    "cost": "2",
    "labor_cost": "4"
},
"SoilI_depth_sizeM": {
    "surface_name": "SoilI",
    "pretty_name": "Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "9",
    "cost": "2",
    "labor_cost": "3"
},
"SoilI_depth_sizeS": {
    "surface_name": "SoilI",
    "pretty_name": "Loam",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "9",
    "cost": "2",
    "labor_cost": "2"
},
"SoilJ_depth_sizeL": {
    "surface_name": "SoilJ",
    "pretty_name": "Sand",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "10",
    "cost": "2",
    "labor_cost": "4"
},
"SoilJ_depth_sizeM": {
```

```
    "surface_name": "SoilJ",
    "pretty_name": "Sand",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "10",
    "cost": "2",
    "labor_cost": "3"
},
"SoilJ_depth_sizeS": {
    "surface_name": "SoilJ",
    "pretty_name": "Sand",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "10",
    "cost": "2",
    "labor_cost": "2"
},
"SoilK_depth_sizeL": {
    "surface_name": "SoilK",
    "pretty_name": "Loamy-Sand",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "4"
},
"SoilK_depth_sizeM": {
    "surface_name": "SoilK",
    "pretty_name": "Loamy-Sand",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "3"
},
"SoilK_depth_sizeS": {
    "surface_name": "SoilK",
    "pretty_name": "Loamy-Sand",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "11",
    "cost": "2",
    "labor_cost": "2"
},
"SoilL_depth_sizeL": {
    "surface_name": "SoilL",
    "pretty_name": "Sandy-Loam",
    "depth_size": "L",
```

```
    "depth_value": "1.0",
    "landuse": "12",
    "cost": "2",
    "labor_cost": "4"
},
"SoilL_depth_sizeM": {
    "surface_name": "SoilL",
    "pretty_name": "Sandy-Loam",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "12",
    "cost": "2",
    "labor_cost": "3"
},
"SoilL_depth_sizeS": {
    "surface_name": "SoilL",
    "pretty_name": "Sandy-Loam",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "12",
    "cost": "2",
    "labor_cost": "2"
},
"SoilM_depth_sizeL": {
    "surface_name": "SoilM",
    "pretty_name": "Rock",
    "depth_size": "L",
    "depth_value": "1.0",
    "landuse": "13",
    "cost": "2",
    "labor_cost": "4"
},
"SoilM_depth_sizeM": {
    "surface_name": "SoilM",
    "pretty_name": "Rock",
    "depth_size": "M",
    "depth_value": "0.5",
    "landuse": "13",
    "cost": "2",
    "labor_cost": "3"
},
"SoilM_depth_sizeS": {
    "surface_name": "SoilM",
    "pretty_name": "Rock",
    "depth_size": "S",
    "depth_value": "0.25",
    "landuse": "13",
    "cost": "2",
```

```
        "labor_cost": "2"
    },
    "SoilN_depth_sizeL": {
        "surface_name": "SoilN",
        "pretty_name": "Water",
        "depth_size": "L",
        "depth_value": "1.0",
        "landuse": "14",
        "cost": "2",
        "labor_cost": "4"
    },
    "SoilN_depth_sizeM": {
        "surface_name": "SoilN",
        "pretty_name": "Water",
        "depth_size": "M",
        "depth_value": "0.5",
        "landuse": "14",
        "cost": "2",
        "labor_cost": "3"
    },
    "SoilN_depth_sizeS": {
        "surface_name": "SoilN",
        "pretty_name": "Water",
        "depth_size": "S",
        "depth_value": "0.25",
        "landuse": "14",
        "cost": "2",
        "labor_cost": "2"
    }
}
```


0.3.6 To access GI SpreadSheet

Use the variable **hs_spreadsheet**

```
In [12]: import json
         from collections import OrderedDict
         data = json.loads(hs_spreadsheet, object_pairs_hook=OrderedDict)
         print(json.dumps(data, indent=4));
```


```
{
    "header": [
        "ID",
        "Type",
        "Name",
        "Count",
        "Unit",
```

```
        "Cost ($US)/Unit",
        "Labor Time (hr)/Unit",
        "Total Cost ($US)"
    ],
    "footer": [
        "ID",
        "Type",
        "Name",
        "Count",
        "Unit",
        "Cost ($US)/Unit",
        "Labor Time (hr)/Unit",
        "Total Cost ($US)"
    ],
    "body": [
        [
            "1",
            "Tree",
            "Maple",
            "1",
            "n/a",
            "150",
            "500",
            "650.00"
        ],
        [
            "2",
            "Tree",
            "Maple",
            "1",
            "n/a",
            "150",
            "500",
            "650.00"
        ],
        [
            "3",
            "Stratum",
            "Evergreen",
            "18.94",
            "cubic meters",
            "2",
            "3",
            "94.70"
        ],
        [
            "4",
            "Soil",
```

```
            "Clay",
            "26.33",
            "cubic meters",
            "2",
            "3",
            "131.65"
        ],
        [
            "999999",
            "Total Cost",
            "",
            "",
            "",
            "",
            "",
            "1526.35"
        ]
    ]
}
```

In [ ]: