wissen wohin
savoir où
sapere dove
knowing where

swisstopo

ESRI Quality Control:

An experience report

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What did I want

You asked me for a field report about the ESRI ProSuite

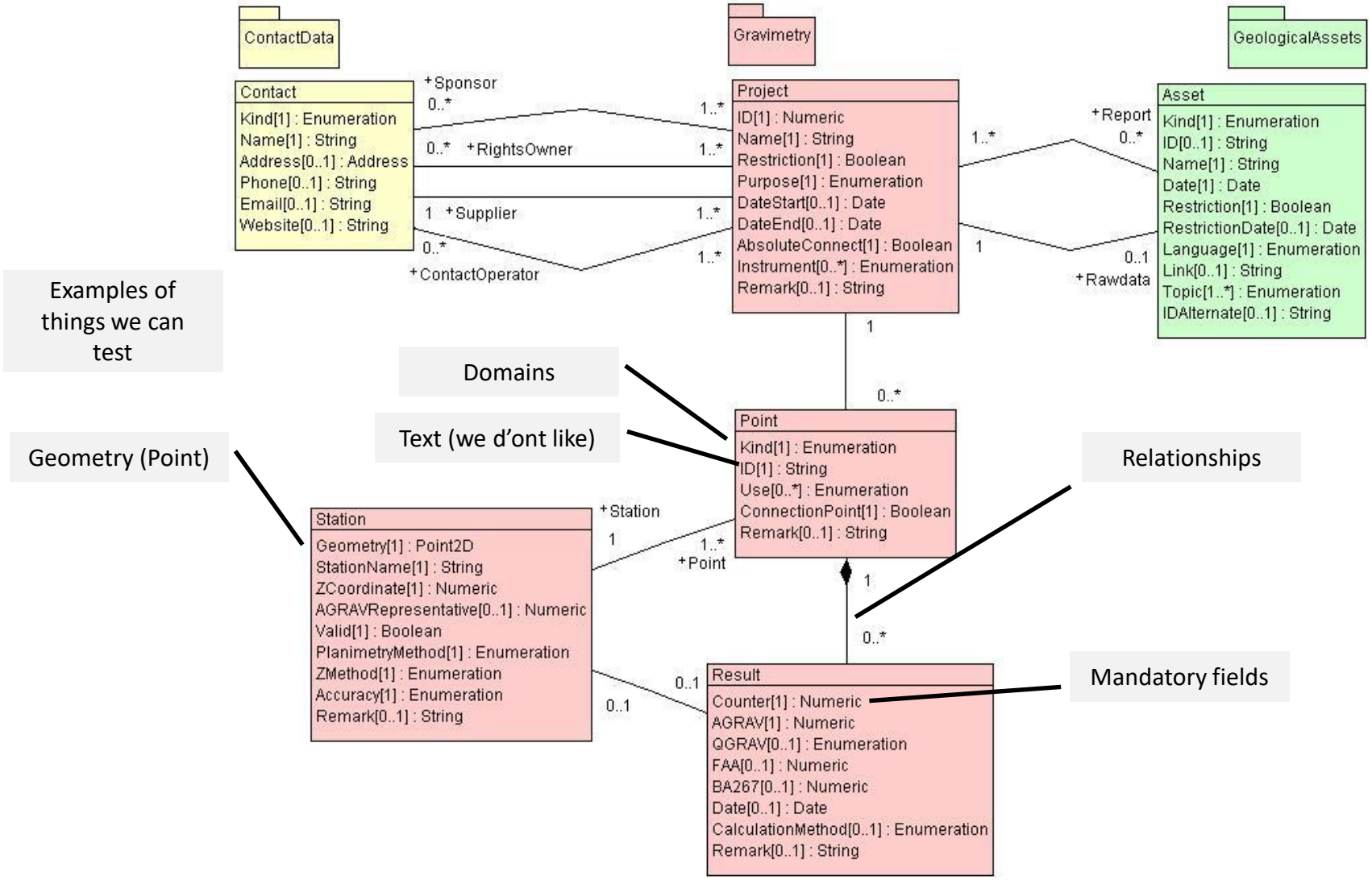
- I searched for data where I can implement a QA specification.
  → That was the easy part
- Then I was looking for descriptions of the data model
  → Also easy ☺. I found a UML diagram and text
- Next, find the data. Another easy step.
  → I asked my colleague. He gave me a file geodatabase.
- Finally, find the documentation for the ESRI ProSuite QA framework. The software was already installed (32bit and 64bit). The documentation you will find at the 32bit version.
  → EsriCH.QA.Tests.QuickReference_en.pdf
  → ProSuite_QA_Tests_en.html

What do we have

- It’s a model to store gravitational measurements
- Data model description as UML and text
- A file geodatabase with data, not yet finished, just a first version. The result will help to ameliorate the importprocess
- A virtual machine with installed 32bit and 64bit software
- The documentation

Important remark:
The model is work in progress. It was defined at the “green table”. We got the data as excel file and try now, to bring them into the model. I'm sure we'll find some small mistakes.

UML


ContactData
Gravimetry
GeologicalAssets
Contact
Kind[1] : Enumeration
Name[1] : String
Address[0..1] : Address
Phone[0..1] : String
Email[0..1] : String
Website[0..1] : String
+Sponsor
0..*
1..*
0..* +RightsOwner
1..*
1 +Supplier
1..*
0..*
1..*
+ContactOperator
Project
ID[1] : Numeric
Name[1] : String
Restriction[1] : Boolean
Purpose[1] : Enumeration
DateStart[0..1] : Date
DateEnd[0..1] : Date
AbsoluteConnect[1] : Boolean
Instrument[0..*] : Enumeration
Remark[0..1] : String
1..*
+Report
0..*
1
0..1
+Rawdata
Asset
Kind[1] : Enumeration
ID[0..1] : String
Name[1] : String
Date[1] : Date
Restriction[1] : Boolean
RestrictionDate[0..1] : Date
Language[1] : Enumeration
Link[0..1] : String
Topic[1..*] : Enumeration
IDAlternate[0..1] : String
1
0..*
Point
Kind[1] : Enumeration
ID[1] : String
Use[0..*] : Enumeration
ConnectionPoint[1] : Boolean
Remark[0..1] : String
Examples of things we can test
Domains
Text (we d'ont like)
Geometry (Point)
Relationships
Mandatory fields
Station
Geometry[1] : Point2D
StationName[1] : String
ZCoordinate[1] : Numeric
AGRAVRepresentative[0..1] : Numeric
Valid[1] : Boolean
PlanimetryMethod[1] : Enumeration
ZMethod[1] : Enumeration
Accuracy[1] : Enumeration
Remark[0..1] : String
+Station
1
1..*
+Point
1
0..*
0..1
0..1
Result
Counter[1] : Numeric
AGRAV[1] : Numeric
QGRAV[0..1] : Enumeration
FAA[0..1] : Numeric
BA267[0..1] : Numeric
Date[0..1] : Date
CalculationMethod[0..1] : Enumeration
Remark[0..1] : String

The model documentation

Section of the object catalog (just in german)

1.2 Klasse Point

In der Klasse Point werden alle Attribute gruppiert, die für die Beschreibung eines gravimetrischen Messpunktes relevant sind:

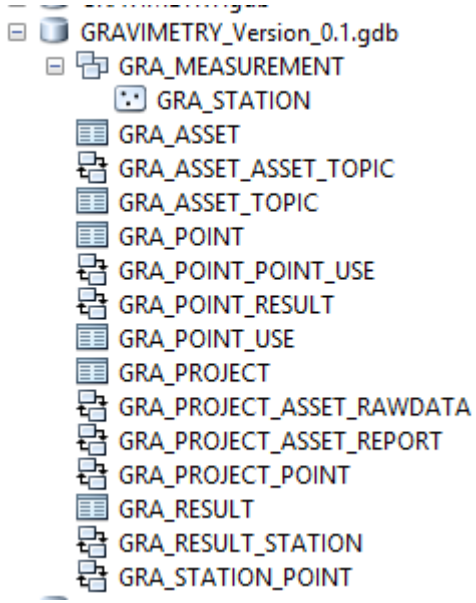
No	Attribut-name	Kardi-nalität	Datentyp	Wertebereich/ Einheit	Beschreibung
1	Geometry	[1]	Coordinate	E und N LV95 [in m]	Geometrie der Obj Point (Messpunkt)
2	Kind	[1]	Enumera-tion	Tabelle 1.2.2	Art des Objektes Messpunkt
3	ID	[1]	Text	10 Zeichen	Identifikator des Messpunktes
4	ZCoordinate	[1]	Numeric	LN02 [in m]	Höhe des Messpunktes
5	QGeometry	[0..1]	Enumera-tion	Tabelle 1.2.5	Methode der Koordinatenbe-stimmung
6	QZ	[1]	Enumera-tion	Tabelle 1.2.6	Methode der Höhenbestim-mung
7	QPoint	[0..1]	Boolean	yes/no	Qualität der Punktdaten
8	Use	[0..*]	Enumera-tion	Tabelle 1.2.9	Verwendung der Messpunkt-daten
9	Remarks	[0..1]	Text	200 Zeichen	Bemerkung zum Messpunkt

1.2.2 Kind

Die nachfolgende Auflistung gibt die zulässigen Werte der Objektart Point (Messpunkt) an. Die verschiedenen Ordnungen der Messpunkte sind in Kap. I, 1.2.2 kurz beschrieben.

GeolCode	Attributwert DE	Beschreibung
	Absolutpunkt, 0. Ordnung	Absolutstationen und deren Exzentren
	Relativpunkt, 1. Ordnung	LSN-Punkte 1. Ordnung
	Relativpunkt, 2. Ordnung	LSN-Punkte 2. Ordnung
	Relativpunkt, 3. Ordnung	LSN-Punkte 3. Ordnung
	Nivellement	Punkt des Landesnivellements

File geodatabase



Field Name	Data Type
OBJECTID	Object ID
Shape	Geometry
UUID	Guid
NAME	Text
VALID	Long Integer
PLANIMETRY_METHOD	Long Integer
PLANIMETRY_ACCURACY	Long Integer
HEIGHT_METHOD	Long Integer
HEIGHT_ACCURACY	Long Integer
REMARKS	Text
GRA_RESULT_UUID	Guid

Click any field to see its properties.

Field Properties

Alias	Valid	
Allow NULL values	Yes	
Default Value		
Domain	GRA_BOOLEAN_CD	

Let us start to configure
Theory

Important to know:

- In the section **TestDescriptors** you add all TestDescriptor(s) you need. A TestDescriptor descirbes the function in a program library.
- In the section **QualityConditions** you add all QualityCondition(s). A QualityCondition sets the parameter of a TestDescriptor.
- In the section **QualitySpecifications** you add all qualityCondition(s) which should be executed in this specification. A QualitySpecification has a name and a list of QualityCondition(s).

Let us start to configure
it's a XML file (overview)

I got a template from a colleague. The fields of the same colour are keys and create the relations

```
<?xml version="1.0" encoding="utf-8"?>
<DataQuality xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="urn:EsriDE.ProSuite.QA.QualitySpecifications-2.0"
xsi:noNamespaceSchemaLocation="./EsriDE.ProSuite.QA.QualitySpecifications-2.0.xsd">
  <QualitySpecifications>
    <QualitySpecification name="GRAVI Base" listOrder="0">
      <Elements>
        <Element qualityCondition="GRA_Station Name not null" />
      </Elements>
    </QualitySpecification>
  </QualitySpecifications>
  <QualityConditions>
    <QualityCondition name=" GRA_Station Name not null " testDescriptor="Constraint(0)" allowErrors="False">
      <Parameters>
        <Dataset parameter="table" value="GRA_STATION" workspace="GRAVI" />
        <Scalar parameter="constraint" value="NAME IS NULL" />
      </Parameters>
    </QualityCondition>
  </QualityConditions>
  <TestDescriptors>
    <TestDescriptor name="Constraint(0)" allowErrors="false">
      <TestClass type="EsriDE.ProSuite.QA.Tests.QaConstraint" assembly="EsriDE.ProSuite.QA.Tests" constructorIndex="0" />
    </TestDescriptor>
  </TestDescriptors>
  <Workspaces>
    <Workspace id="GRAVI" modelName="GRAVI" />
  </Workspaces>
</DataQuality>
```

Let us start to configure
it's a XML file (TestDescriptors)

Our first test is:
Is the attribute Name in the feature class GRA_Station for any object null or empty?

In the EsriCH.QA.Tests.QuickReference_en.pdf you will find:

Freely defined attribute conditions

Finds rows in tables and feature classes that do not fulfil the defined attribute conditions.

The conditions can be organized in a hierarchical structure. Parent conditions successively restrict the set of rows to be tested. Conditions defined at the lowest hierarchy level are then verified for the resulting set of rows.

Attribute conditions for joined tables can also be tested.

Alternatively, the attribute conditions can be defined in a separate database table.

Tests: *QaConstraint, QaDatasetConstraintFactory, QaRelConstraint, QaConstraintListFactory*

```
Objecttype=Path (Selection)
+Width IS NULL OR
 Width < 4 (Condition)
Objecttype=Motorway (Selection)
+Width > 10 (Condition)
+Surface <> 'Loose' (Condition)
```

	ID	Objecttype	Width	Surface
X	1	Path	6m	Loose
	2	Path	3m	Loose
	3	Motorway	12m	Hard
X	4	Motorway	12m	Loose

Let us start to configure
it's a XML file (TestDescriptors)

In the ProSuite_QA_Tests_en.htm you will find:

QaConstraint		
Categories:	Attributes	
Implementation:	Test class EsriDE.ProSuite.QA.Tests.QaConstraint in EsriDE.ProSuite.QA.Tests.dll	
Issue Code	**Description**	
Constraints.ErrorEvaluatingExpression	Error evaluating constraint expression	
Constraints.ConstraintNotFulfilled	The constraint is not fulfilled	
QaConstraint - constructor index: 0		
Signature:	ITable table, String constraint	
Description:	Finds all rows in 'table' that do not fulfill 'constraint'	
Parameter	**Type**	**Description**
table	ITable	table
constraint	String	checked constraint

```
<TestDescriptors>
  <TestDescriptor name="Constraint(0)" allowErrors="false">
    <TestClass type="EsriDE.ProSuite.QA.Tests.QaConstraint"
               assembly="EsriDE.ProSuite.QA.Tests" constructorIndex="0" />
  </TestDescriptor>
</TestDescriptors>
```

Tip: name equal test + constructorIndex -> Constraint(0)

Let us start to configure
it's a XML file (QualityCondition)

In the ProSuite_QA_Tests_en.htm you will find:

QaConstraint		
Categories:	Attributes	
Implementation:	Test class EsriDE.ProSuite.QA.Tests.QaConstraint in EsriDE.ProSuite.QA.Tests.dll	
Issue Code	**Description**	
Constraints.ErrorEvaluatingExpression	Error evaluating constraint expression	
Constraints.ConstraintNotFulfilled	The constraint is not fulfilled	
QaConstraint - constructor index: 0		
Signature:	`ITable table, String constraint`	
Description:	Finds all rows in 'table' that do not fulfill 'constraint'	
Parameter	**Type**	**Description**
table	ITable	table
constraint	String	checked constraint

```
<QualityCondition name="GRA_Station Name not null" testDescriptor="Constraint(0)
                  allowErrors="False">
  <Parameters>
    <Dataset parameter="table" value="GRA_STATION" workspace="GRAVI" />
    <Scalar parameter="constraint" value="NAME IS NULL" />
  </Parameters>
</QualityCondition>
```

Tip: name: what does the test
testDescriptor links to TestDescriptors

Let us start to configure
it's a XML file (QualityCondition)

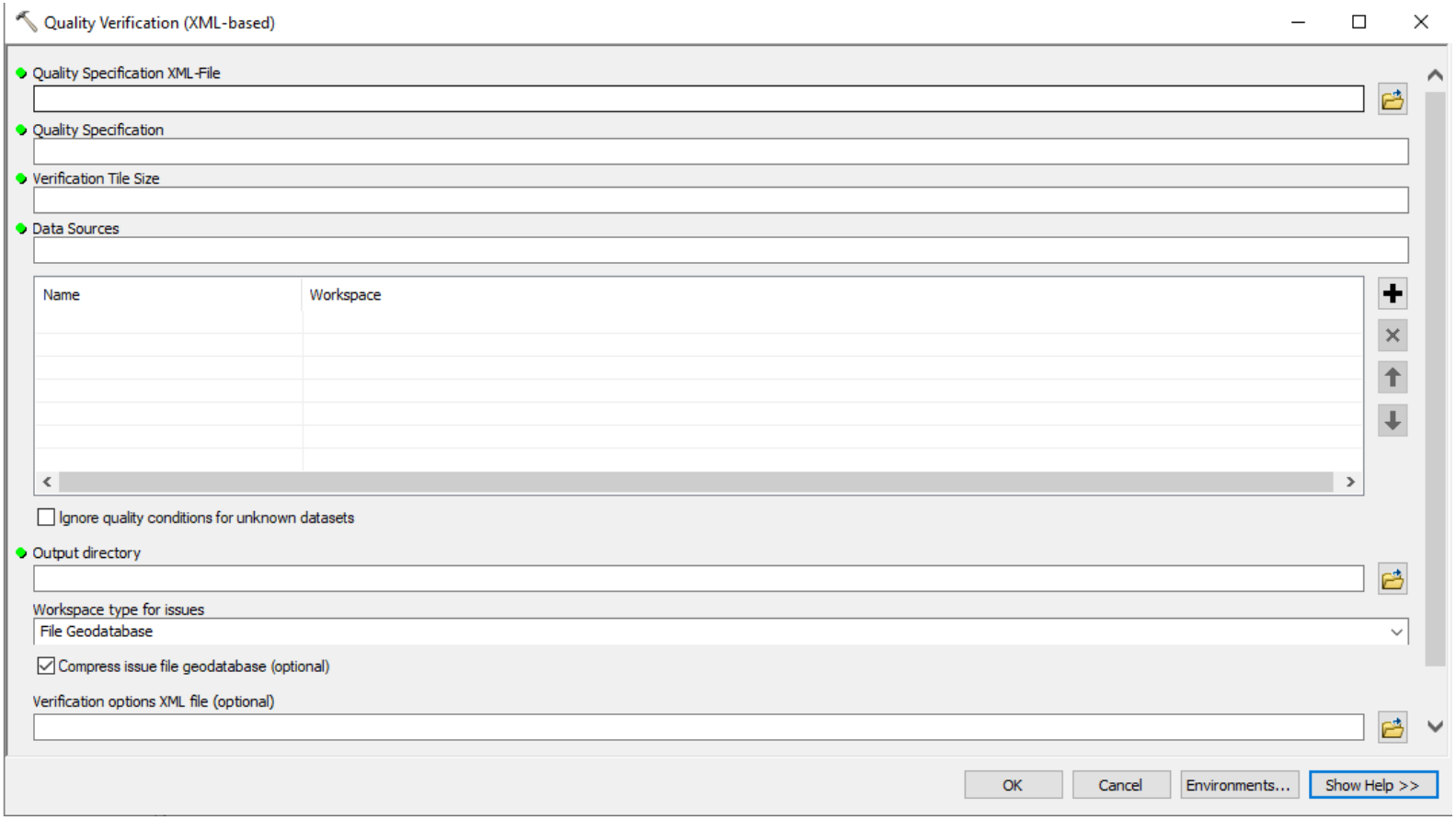
```
<QualitySpecification name="GRAVI Base" listOrder="0">
  <Elements>
    <Element qualityCondition="GRA_Station Name not null" />
  </Elements>
</QualitySpecification>
```

Tip:

- name: what does this set of test(s)
- Elements: contains a list of qualityConditions.
  The `GRA_Station Name not null` corresponds to the attribute name in the section QualityCondition

And now?

- Start GpTool



Launch Pythonscript
my personal preference

```
…
toolbox = os.path.join("C:\\","Program Files", \
  "Esri Switzerland", \
  "ProSuite Geoprocessing","gp","ProSuite.tbx")

arcpy.ImportToolbox(toolbox)
res = arcpy.XmlBasedVerificationTool_ProSuite(
  in_xmlfile="QA.xml",
  in_qualityspecification="GRAVI Base",
  in_tilesize="100000",
  in_datasources="GRAVI.gdb",
  out_outputdirectory=outputdirectory,
  in_issuerepositorytype="File Geodatabase")
…
```

The Results (1/3)
verification.html

Quality Specification	**GRAVI Base**		
Date of verification	9/23/2019 3:37:23 PM	Processing time	00h:00m:06s
Warnings	0	Errors	25
Output directory	QA-Results (orig. path: D:\QA-Results)		
Map document	issues.mxd	Verification report	verification.xml

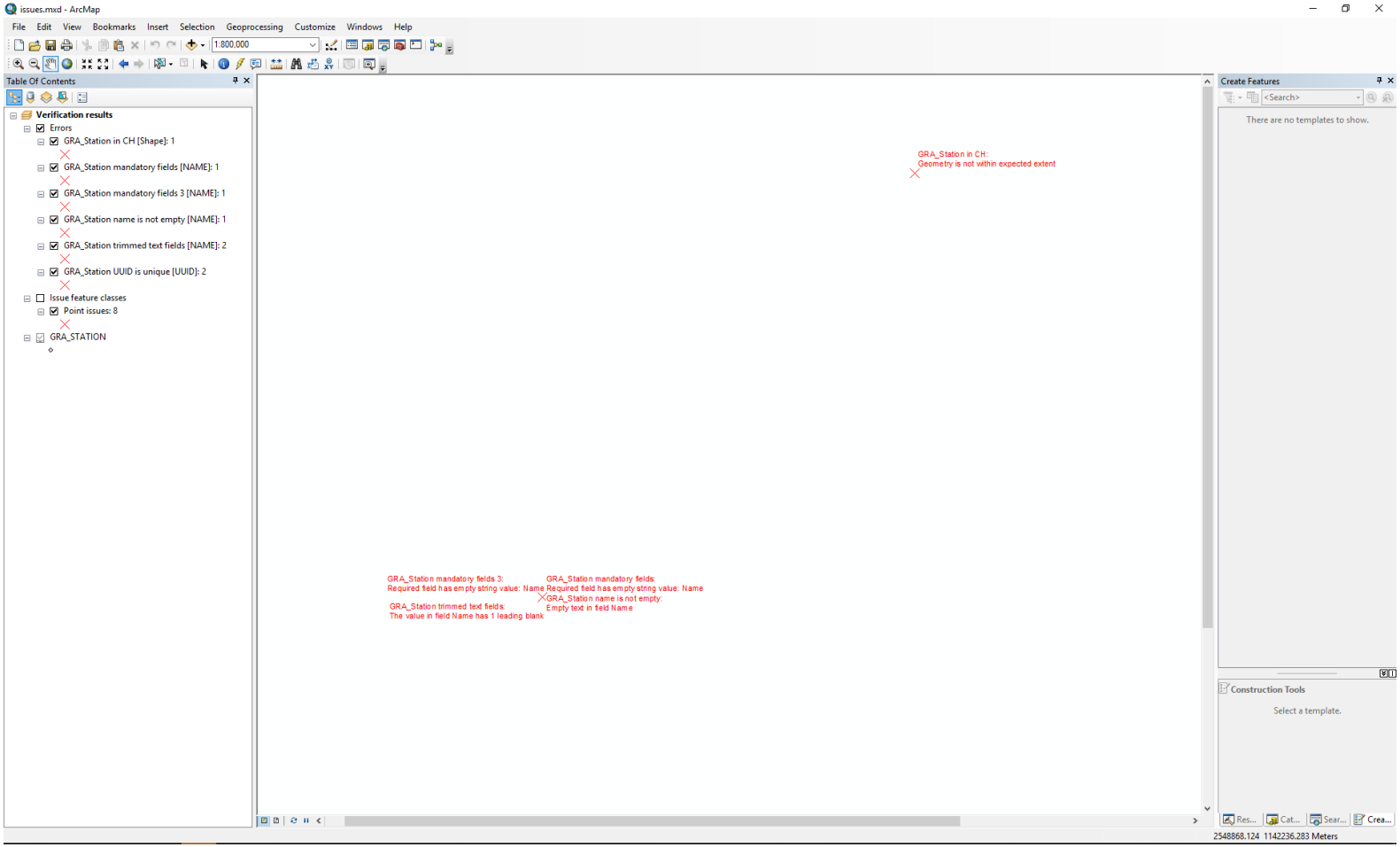
<No category>			25
Quality condition	**Issue description**	**Affected components**	**Issue count**
Each result belongs to a point	The constraint is not fulfilled `Constraints.ConstraintNotFulfilled`		1
GRA_Project domain check	Field value is not valid for domain `GdbAttributeRules.ValueNotValidForDomain`	ABSOLUTE_CONNECT	1
GRA_Project mandatory fields	Required field contains NULL value `RequiredFields.NullValue`	END_DATE	7
GRA_Project counter is unique	Field values are not unique `UniqueFields.NotUnique`	ID	2
GRA_Station mandatory fields	Required field contains an empty string `RequiredFields.EmptyString`	NAME	1
GRA_Station mandatory fields 3	Required field contains an empty string `RequiredFields.EmptyString`	NAME	1
GRA_Station name is not empty	Empty text in field `EmptyNotNullTextFields.EmptyText`	NAME	1
GRA_Station trimmed text fields	The text has one or more blanks at the beginning `TrimmedTextFields.LeadingBlanks`	NAME	1
GRA_Station trimmed text fields	The text has one or more blanks at the end `TrimmedTextFields.TrailingBlanks`	NAME	1
GRA_Project mandatory fields	Required field contains NULL value `RequiredFields.NullValue`	START_DATE	6
GRA_Station in CH	The geometry is not fully within the expected extent `WithinBox.GeometryNotWithinBox`	Shape	1
GRA_Station UUID is unique	Field values are not unique `UniqueFields.NotUnique`	UUID	2

The Results (2/3)
qualityspecification.html
just a part of a more complex specification

› GRA_STATION (Point)				
Quality Condition	**Parameter**	**Filter expression**	**Reference data**	**Issue Type**
GRA_Station data type check	table		No	Error
GRA_Station domain check	table		No	Error
GRA_Station domain check1	table		No	Error
GRA_Station in CH	featureClass		No	Error
GRA_Station mandatory fields	table		No	Error
GRA_Station mandatory fields 3	table		No	Error
GRA_Station Name not null	table		No	Error
GRA_Station name is not empty	table		No	Error
GRA_Station non empty geometry	featureClass		No	Error
GRA_Station trimmed text fields	table		No	Error
GRA_Station UUID is unique	table		No	Error
GRA_Station z is valid	featureClass		No	Error

GRA_Station Name not null				
Category				
Test	Constraint(0)			
UUID	72D98F1F-B61F-4377-BFCE-B5B716DC363D			
Version UUID	4ADDBDB2-CEF1-4985-A7EB-0907C3B40E59			
Parameter	**Value**	**Data model**	**Filter expression**	**Reference data**
table	GRA_STATION (Point)	GRAVI		No
constraint	NAME IS NOT NULL			

The Results (3/3)
issues.mxd



Conclusion

- Yes, you can
- It’s not easy, you have to know XML
- You need a example to start
- You need time
- But you know what you test

What can I offer to you?

- The GRAVIMETRY – Schema (ESRI file geodatabase XML)
- My first QA.XML with 35 Tests
- A small python script to launch the gptool