A Customized GIS Tool for Oil Spill Sensitivity Mapping

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Introduction

Environmental Resources Management (ERM)

ERM has 130 offices across the following countries

Argentina
Australia
Belgium
Brazil
Canada
China
Colombia
France
Germany
Hong Kong
Hungary
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Korea
Malaysia
Mexico
The Netherlands
New Zealand
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Singapore
South Africa
Spain
Sweden
Taiwan
Thailand
United Arab Emirates
UK
US
Vietnam

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- **Project Background**
- Approach
- Problem
- Solution
- Conclusions

Project Background

Oil Spill Sensitivity Mapping

Contingency Planning Process

Useful for Decision makers

- Project Background
- **Approach**
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Approach

1. Define the Study Area
2. Identify Data Sources
3. Collect Information
4. Assess Sensitivity
5. Apply Results

2. Identify Data Sources

The receptor identification process started with determining three main themes

Shoreline

- Shoreline type

Natural Environment

- International and National Designated Areas. Protected Areas.

Human Environment

- Roads, Fisheries, Beaches, Recreational water activities, Archaeological sites…

3. Collect Information

1. Needs Assessment

- How do stakeholders need to access GIS data?

2. System Design

- Data storage format and location
- GIS data standards
- QA/QC protocols

3. Collect Data

- Follow data collection strategy and system design
- Track progress

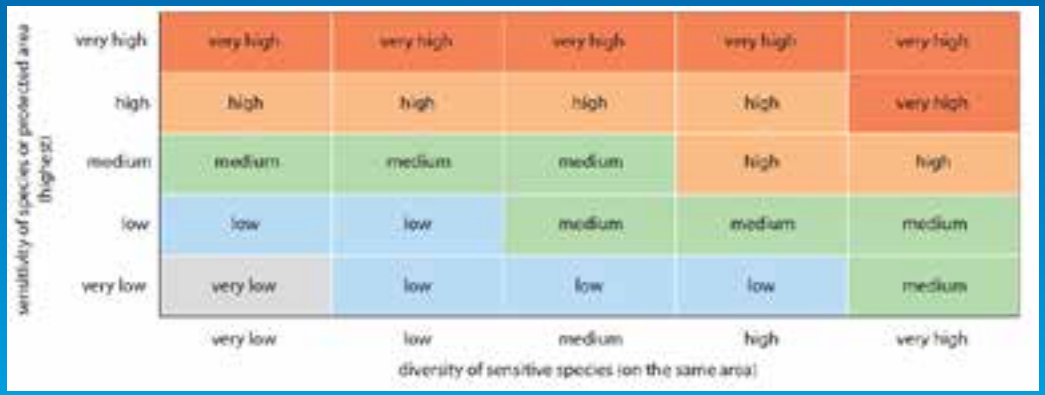
4. Assess Sensitivity

Traditional Approach

Table 1 – Shoreline Sensitivity

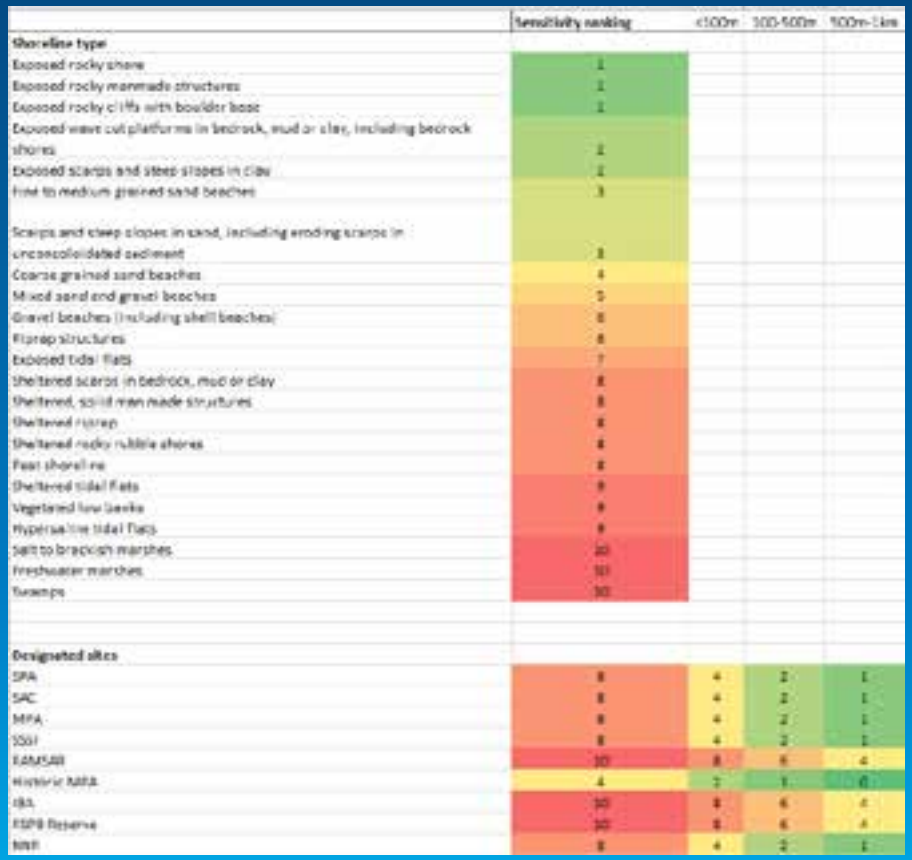
ESI (from 1 to 10)		Simplified ESI	Mapping of simplified ESI
Index 1 and 2	→	1 (very low)	Not represented
Indexes 3, 4, 5 and 6	→	2 (low)	Not represented
Index 7	→	3 (medium)	Not represented
Index 8	→	4 (high)	4 (high)
Index 9 and 10	→	5 (very high)	5 (very high)

Table 2 – Natural Environment



4. Assess Sensitivity

‘Heat Map’ Approach

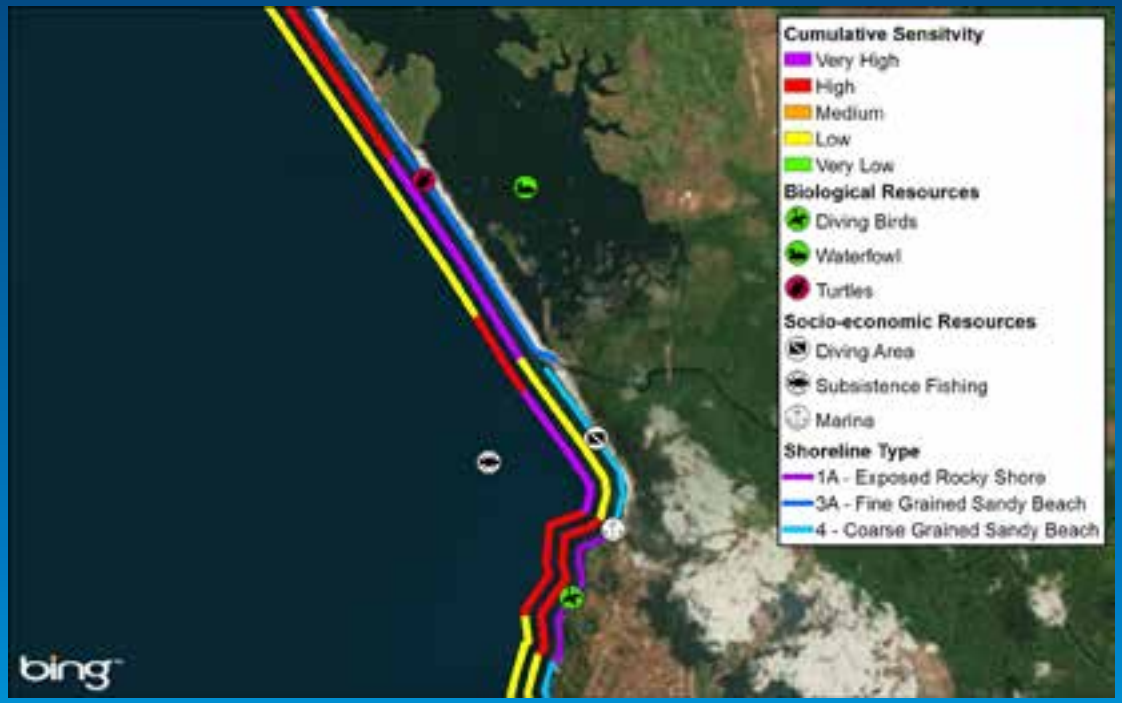


	Sensitivity ranking	<100m	100-500m	500m-1km
Shoreline type				
Exposed rocky shore	1			
Exposed rocky manmade structures	1			
Exposed rocky cliffs with boulder base	1			
Exposed wave cut platforms in bedrock, mud or clay, including bedrock shores	2			
Exposed scarps and steep slopes in clay	2			
Fine to medium grained sand beaches	3			
Scarps and steep slopes in sand, including eroding scarps in unconsolidated sediment	3			
Coarse grained sand beaches	4			
Mixed sand and gravel beaches	5			
Gravel beaches (including shell beaches)	6			
Riprap structures	6			
Exposed tidal flats	7			
Sheltered scarps in bedrock, mud or clay	8			
Sheltered, solid man made structures	8			
Sheltered riprap	8			
Sheltered rocky rubble shores	8			
Peat shoreline	8			
Sheltered tidal flats	9			
Vegetated low banks	9			
Hypersaline tidal flats	9			
Salt to brackish marshes	10			
Freshwater marshes	10			
Swamps	10			
Designated sites				
SPA	8	4	2	1
SAC	8	4	2	1
MPA	8	4	2	1
SSSI	8	4	2	1
RAMSAR	10	8	6	4
Historic MPA	4	2	1	0
IBA	10	8	6	4
FSPB Reserve	10	8	6	4
NNR	8	4	2	1

Category	Symbol	Comments	Rank
Access		Vehicular access to the shoreline	2
Aquaculture	AQ	Hatcheries, ponds, and pens	8
Archaeological Site		Water-, coastal-, or wetland-associated	8
Beach		High-use recreational beaches	8
Boat Ramp			2
Coast Guard			3
Commercial Fishing			8
Diving		High-use recreational areas	8
Dredging		Data on dredging and disposal sites on Marine Scotland website	5

5. Apply Results

Traditional Approach



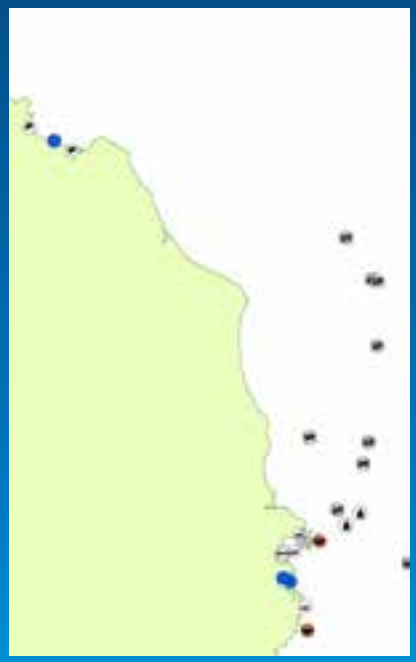
5. Apply Results

‘Heat Map’ Approach

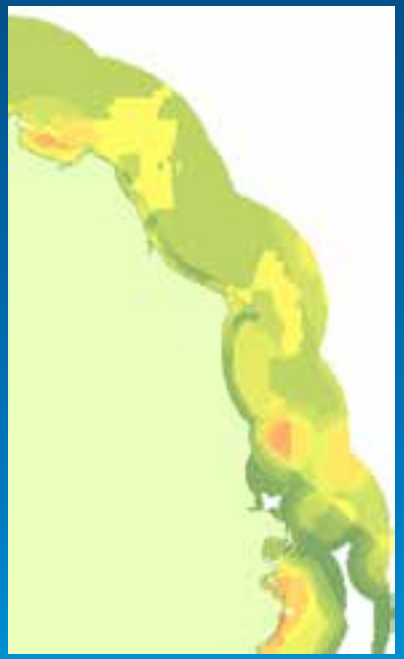
Shoreline Type

Natural Environment

Human Environment



Sensitivity



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Problem

How do we efficiently score/rank a large number of datasets and produce a final sensitivity (heat) map?

Prerequisite's

- Automate, develop tool…
- Needs to be intuitive and easy to use
- Be able to re-use on similar projects
- Efficient, the tool needs to be able to re-model as it’s expected that key stakeholders will require small amendments to the rank/scoring matrix

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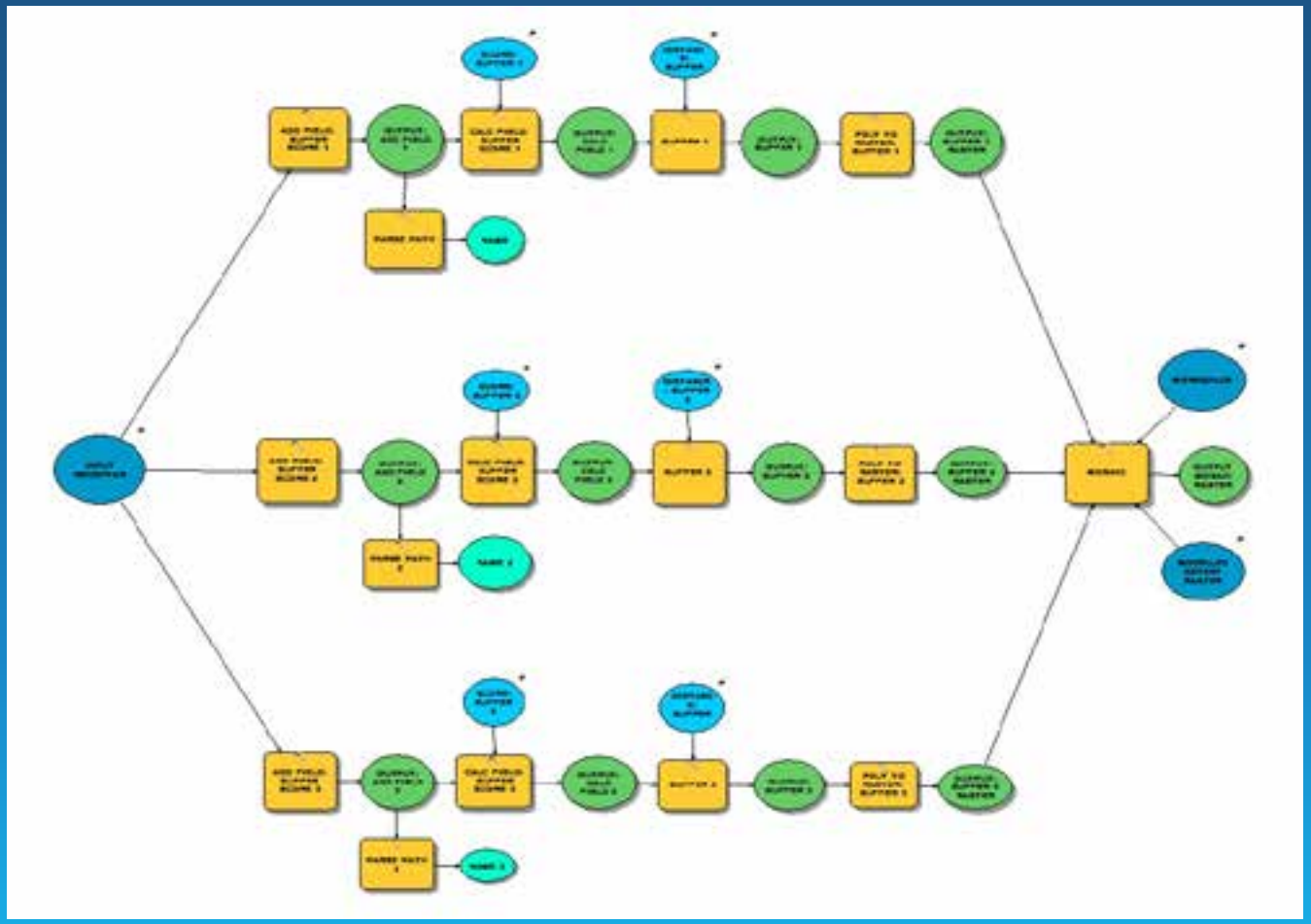
Solution

Step 1 - Model Builder



Solution

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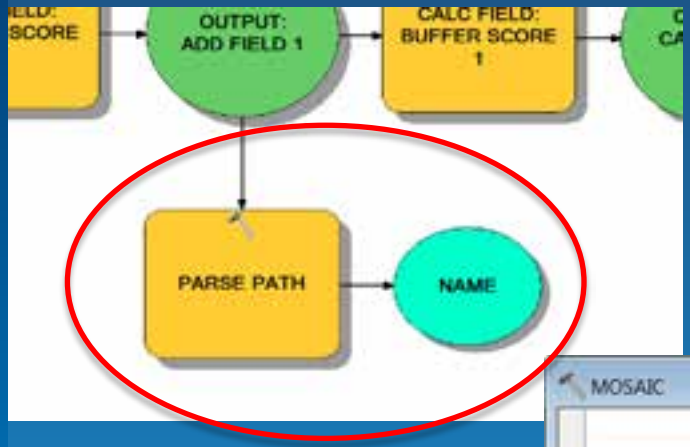

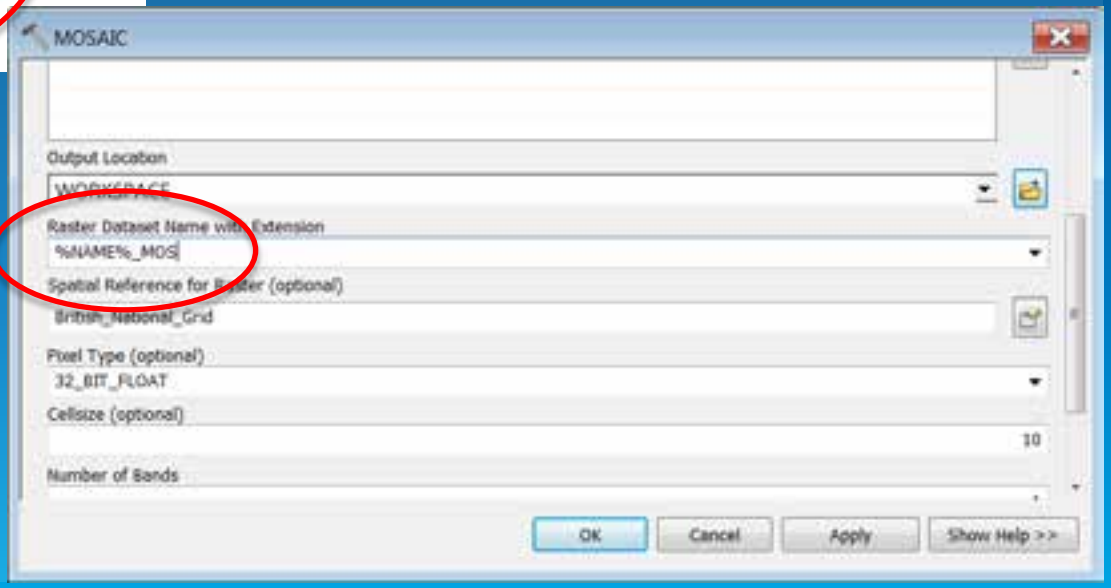

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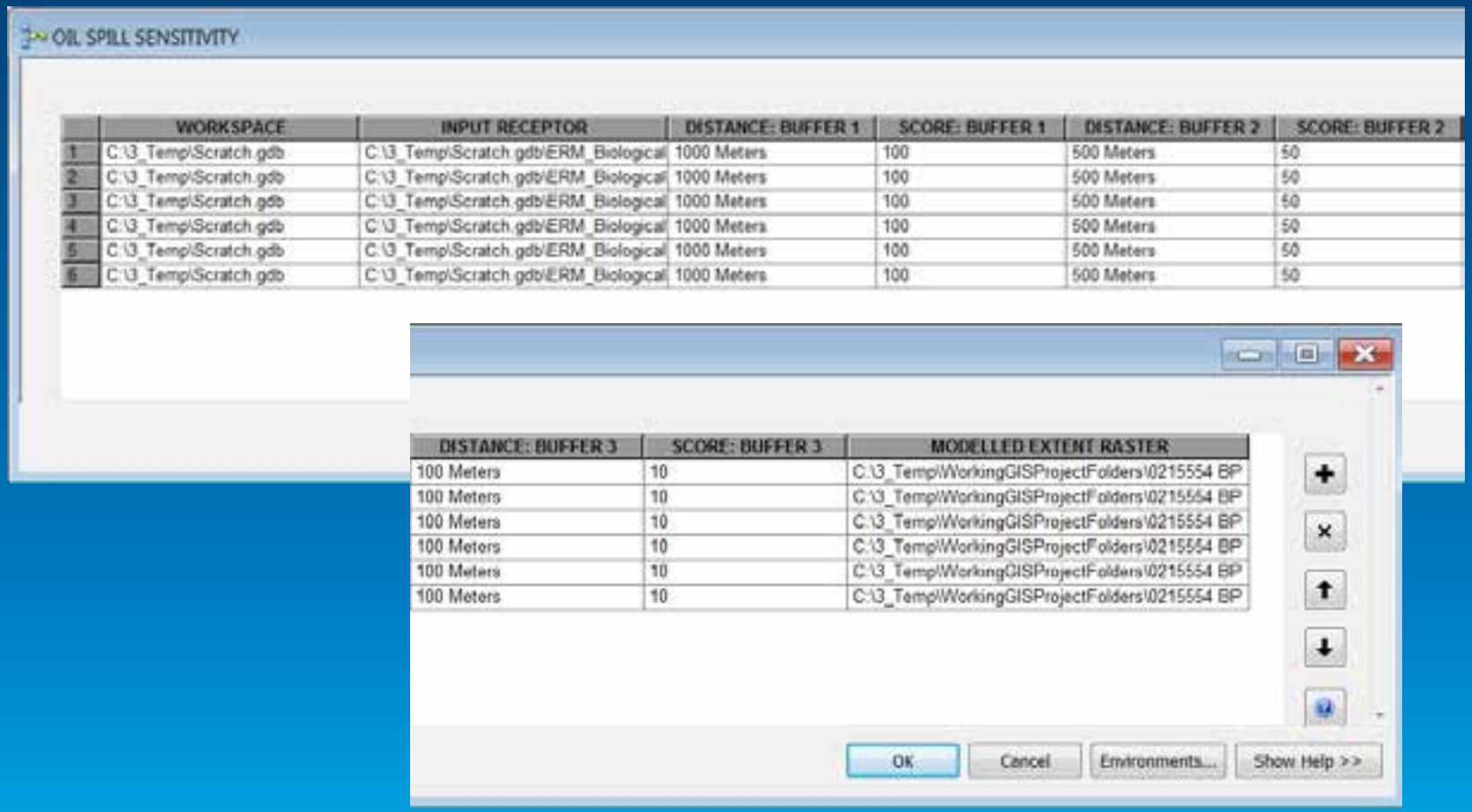
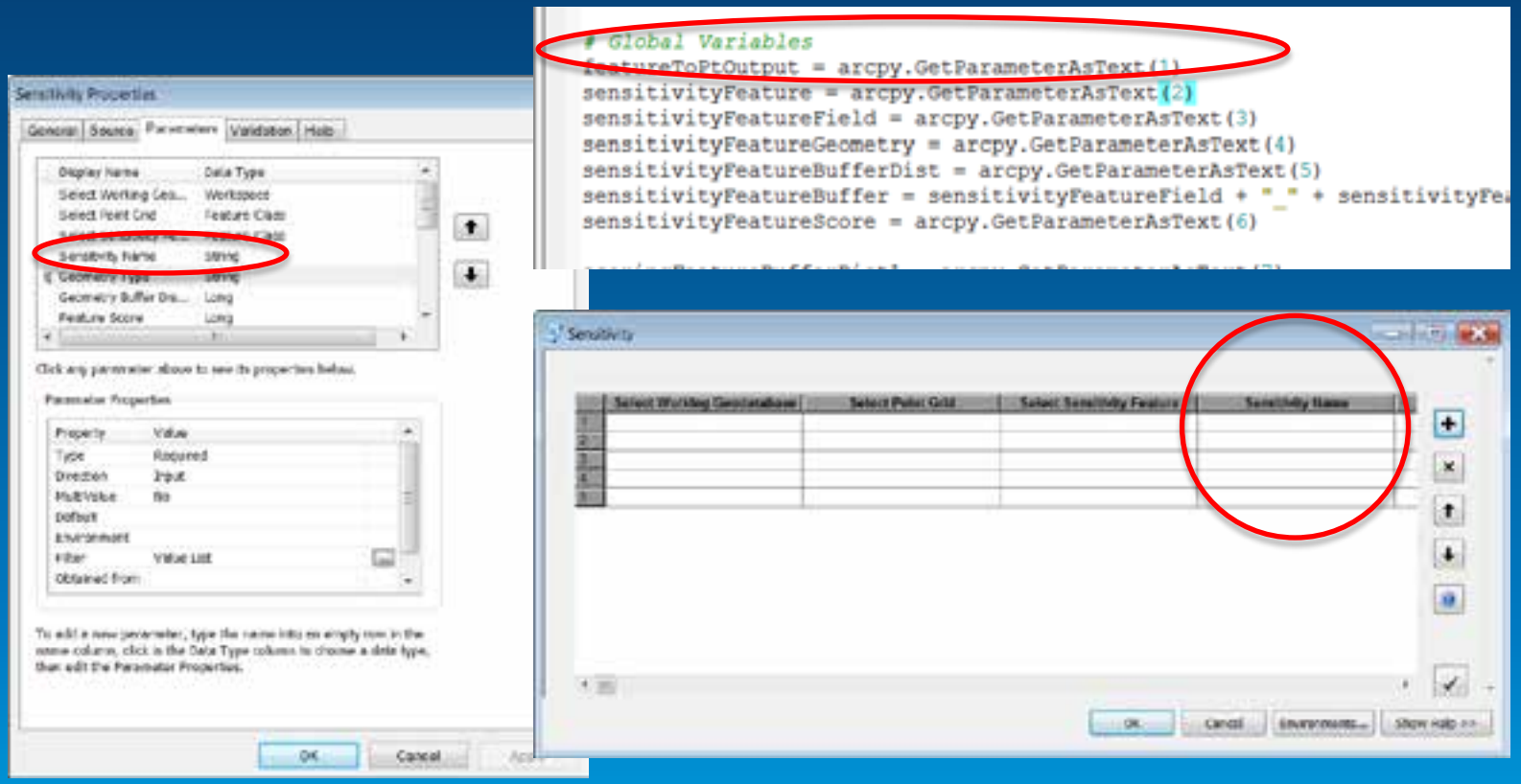


Solution

Step 2 - Python



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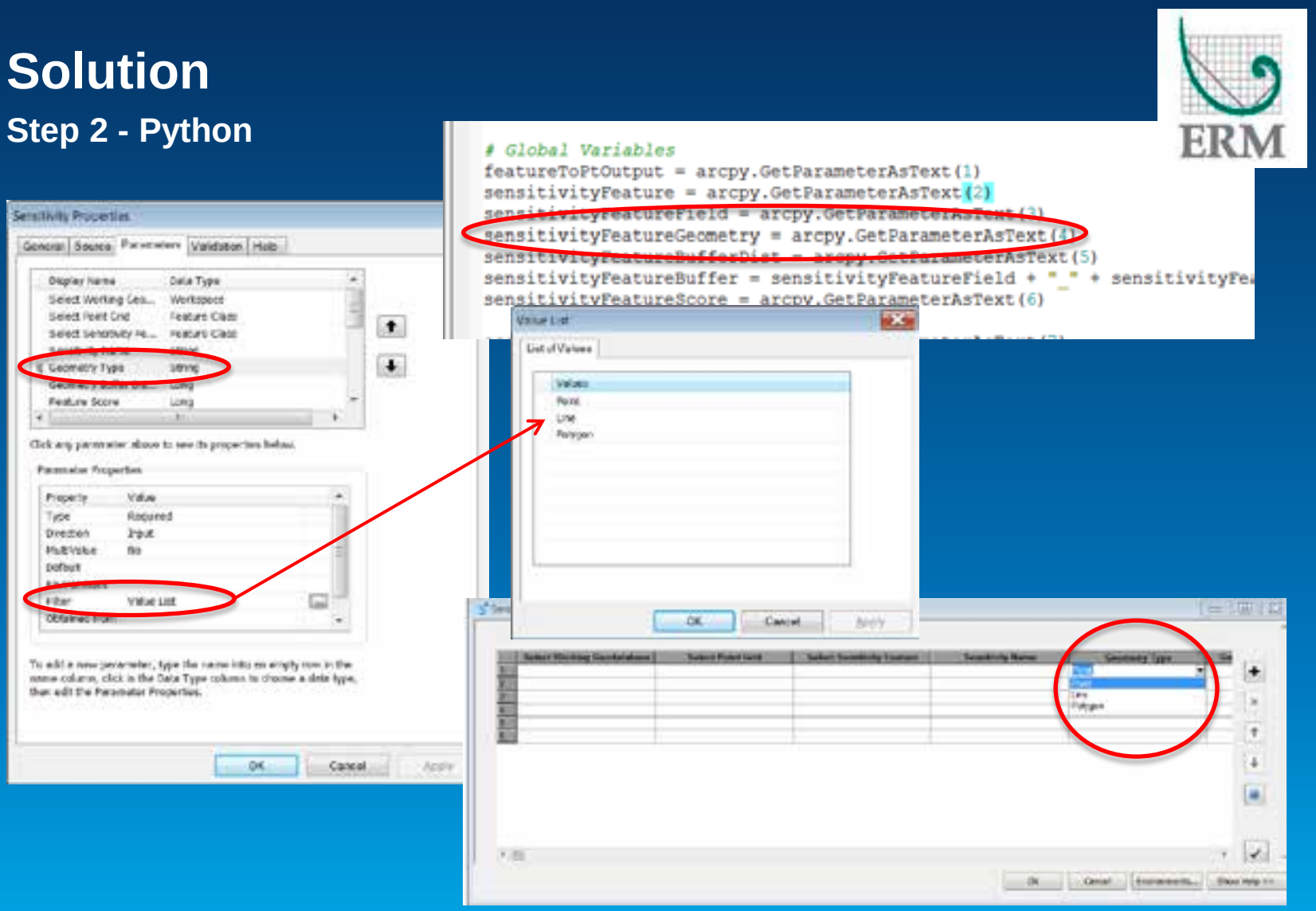

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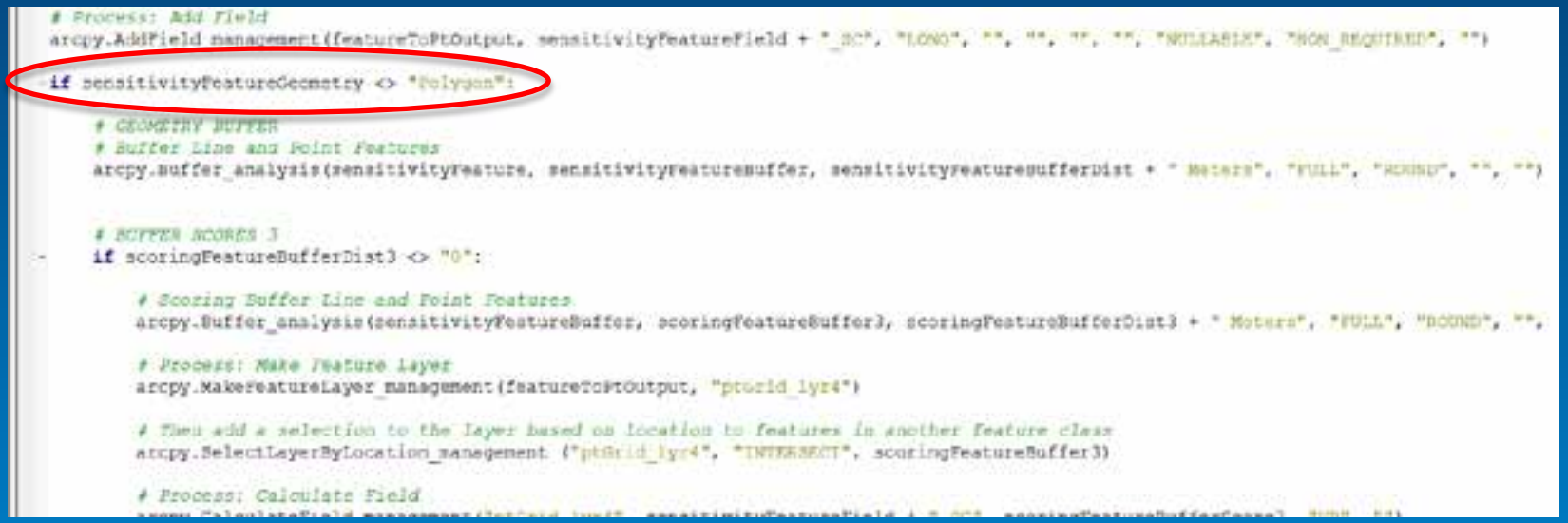
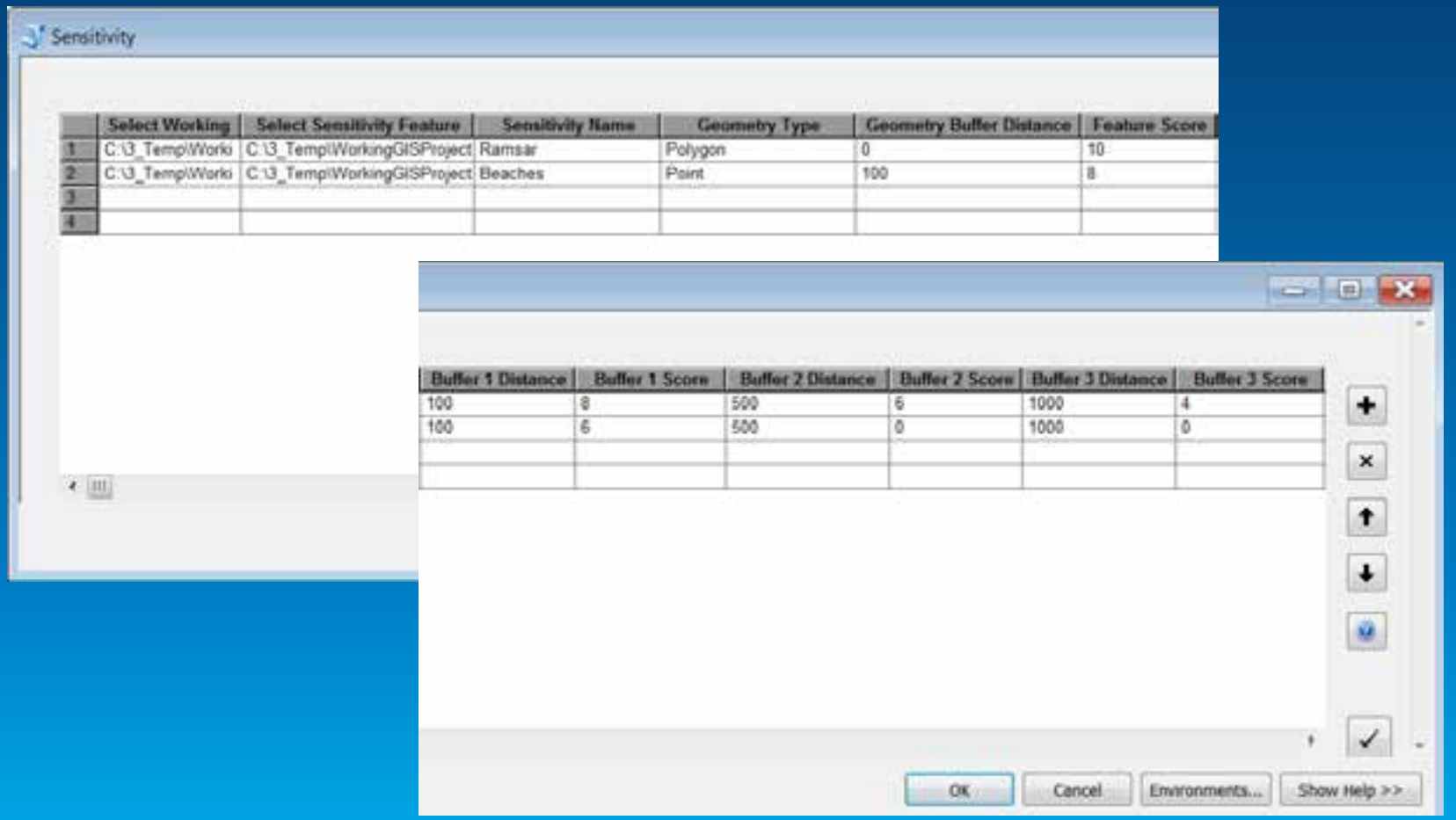


```
# Process: Add Field
arcpy.AddField_management(featureToPtOutput, sensitivityFeatureField + "_SC", "LONG", "", "", "", "", "NULLABLE", "NON_REQUIRED", "")

if sensitivityFeatureGeometry <> "Polygon":

    # GEOMETRY BUFFER
    # Buffer Line and Point Features
    arcpy.Buffer_analysis(sensitivityFeature, sensitivityFeatureBuffer, sensitivityFeatureBufferDist + " Meters", "FULL", "ROUND", "", "")


    # BUFFER SCORES 3
    if scoringFeatureBufferDist3 <> "0":

        # Scoring Buffer Line and Point Features
        arcpy.Buffer_analysis(sensitivityFeatureBuffer, scoringFeatureBuffer3, scoringFeatureBufferDist3 + " Meters", "FULL", "ROUND", "",

        # Process: Make Feature Layer
        arcpy.MakeFeatureLayer_management(featureToPtOutput, "ptGrid_lyr4")

        # Then add a selection to the layer based on location to features in another feature class
        arcpy.SelectLayerByLocation_management ("ptGrid_lyr4", "INTERSECT", scoringFeatureBuffer3)

        # Process: Calculate Field
```

Solution

Step 2 - Python



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Conclusions

- An alternative way to view/assess cumulative sensitivity rankings
- The ability to model and re-model sensitivity
- Improved data management workflows
- Easy to use and transferable
- Efficiency savings

Questions ?