

# **Integrated GIS and Microbial Water Quality Modeling through use of Network Processing**

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# *The purpose of this presentation is*

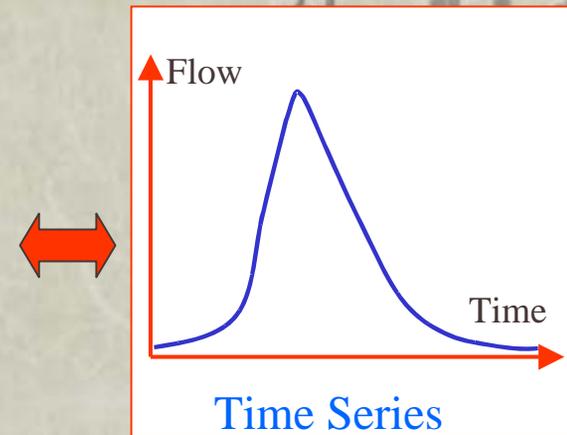
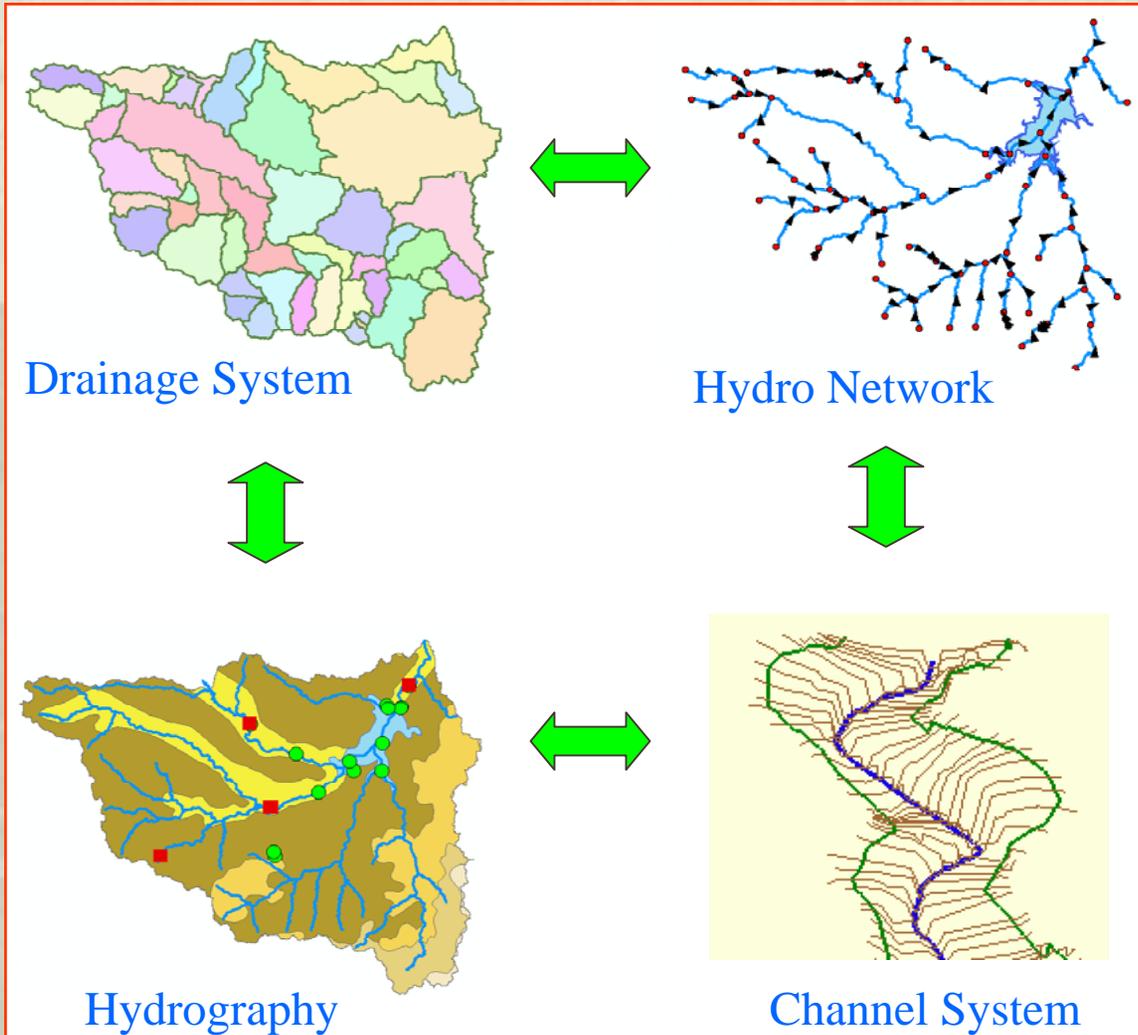
- To provide you with some inside of the **ArcHydro Network** feature dataset and
- To demonstrate the capabilities of a geometric network to identify **Contamination** in streams

# *What is Arc Hydro?*

A geographic data model for storing geo- spatial and temporal water resources data in ArcGIS

- A set of **hydro objects** built on top of ArcObjects
- A set of **standardized attributes**
- A **vocabulary** for describing data (glossary)
- A **toolset** for implementing the data model

# Arc Hydro Components





Geodatabase

# Overview of the ArcHydro framework data model

Feature dataset ArcHydro



Geometric network HydroNetwork

Hydro junctions are a set of points located at the ends of flow segments and at other strategic locations on the flow network.

**Simple junction feature class HydroJunction**

**Complex edge feature class HydroEdge**

Subtypes: Floodline, Shoreline

Hydro edges are the network of lines describing map hydrography. There are two types: flowlines, which trace water movement and shorelines, which form the interface between land and water.

**Relationship class HydroJunction-HasWaterbody**

One to many

**Polygon feature class Waterbody**

Waterbodies are all the significant ponds, lakes, and bays in the water system.

**Relationship class HydroJunction-HasWatershed**

One to many

**Polygon feature class Watershed**

Watersheds are the drainage areas contributing flow from the land surface to the water system.

**Relationship class HydroJunctionHasMonitoringPoint**

One to many

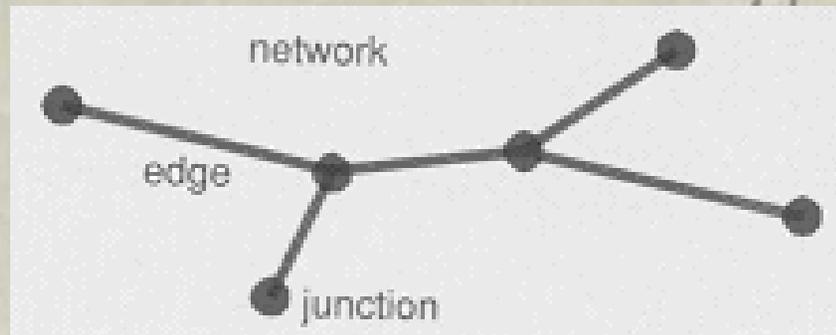
**Point feature class MonitoringPoint**

MonitoringPoints are locations where water is measured, such as stream gauges, rainfall gauges, or water quality monitoring sites.

# HydroNetwork

The *Network* feature dataset describes the connectivity of water flow through the landscape as a water resources network

**HydroNetwork** is the principal feature class of this dataset: It is an ArcGIS geometric network, whose components are *HydroEdges* and *HydroJunctions*



Water flows along *HydroEdges*, and *HydroEdges* are connected by *HydroJunctions*

*The HydroNetwork describes flow through rivers and streams, and the centerlines of waterbodies*

# NATIONAL MICROBIAL MONITORING PROGRAMME

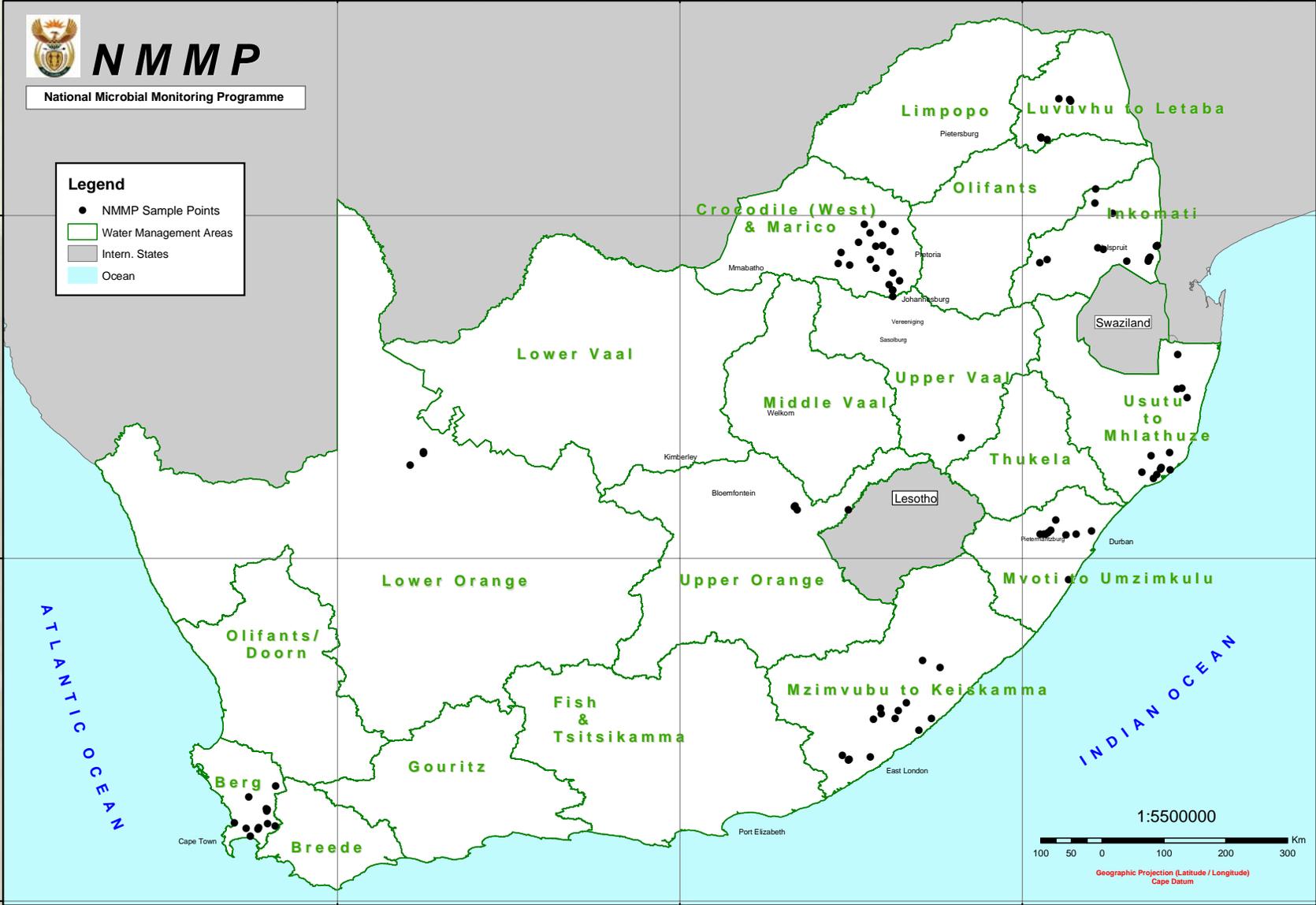


## NMMP

National Microbial Monitoring Programme

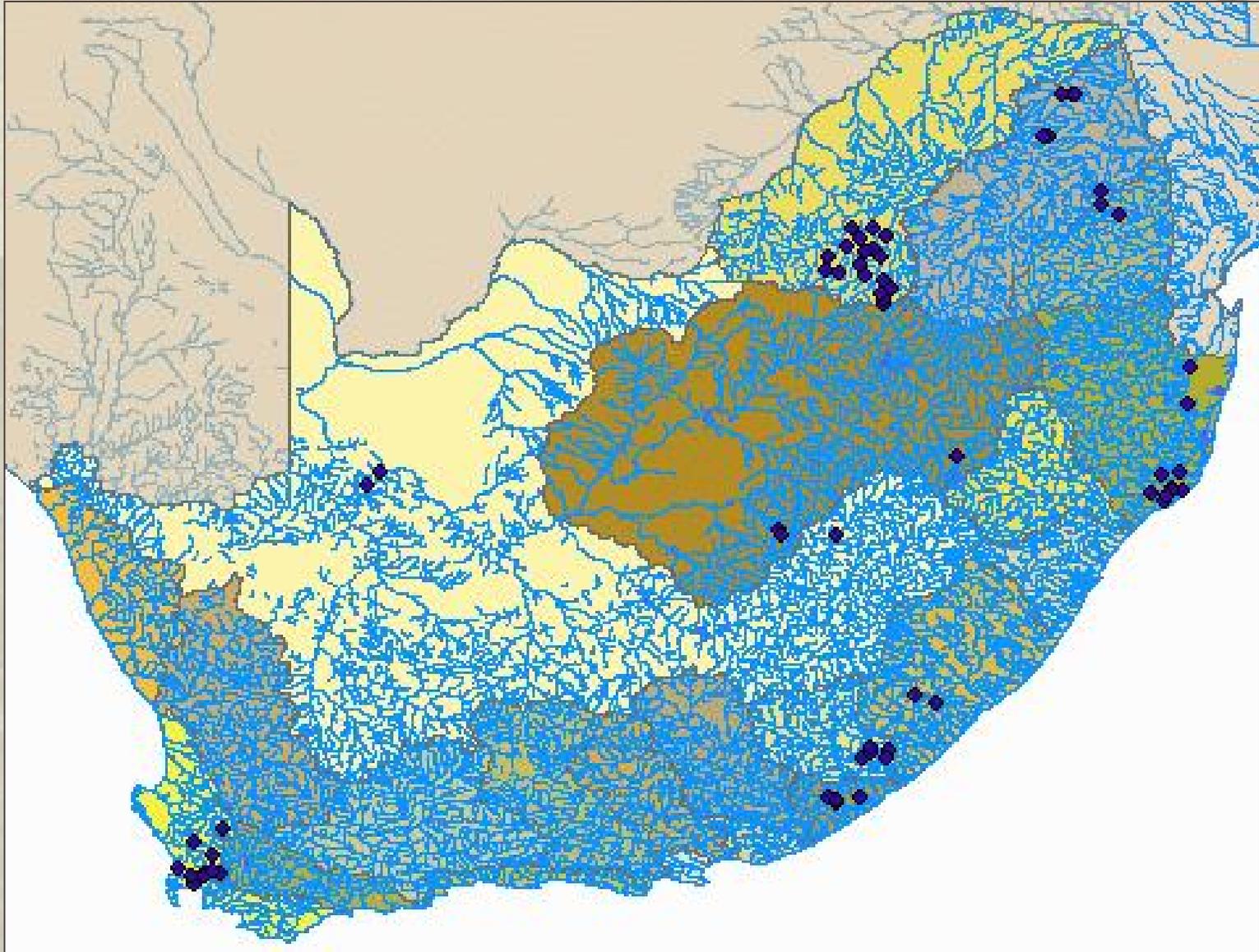
### Legend

- NMMP Sample Points
- Water Management Areas
- Intern. States
- Ocean

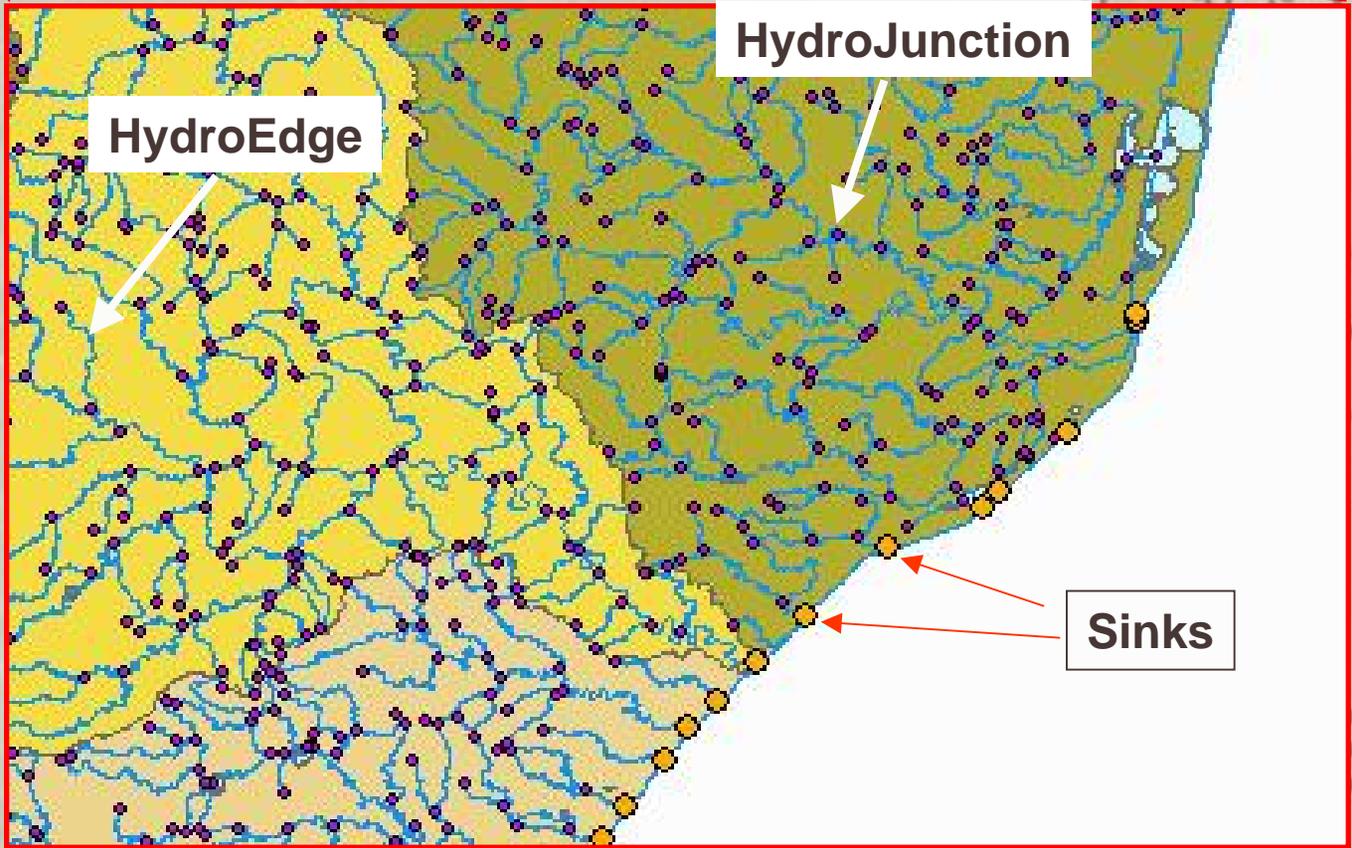
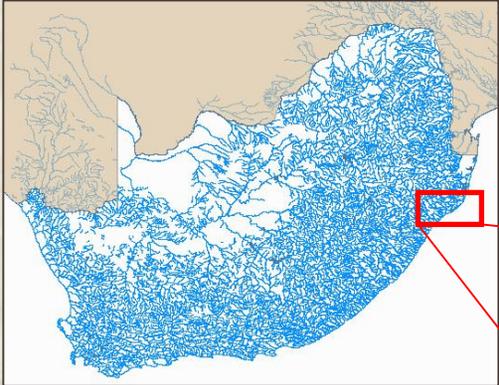


# ArchHydro Network RSA at 1 : 500 000

Including the spatial distribution of Microbial Monitoring Points

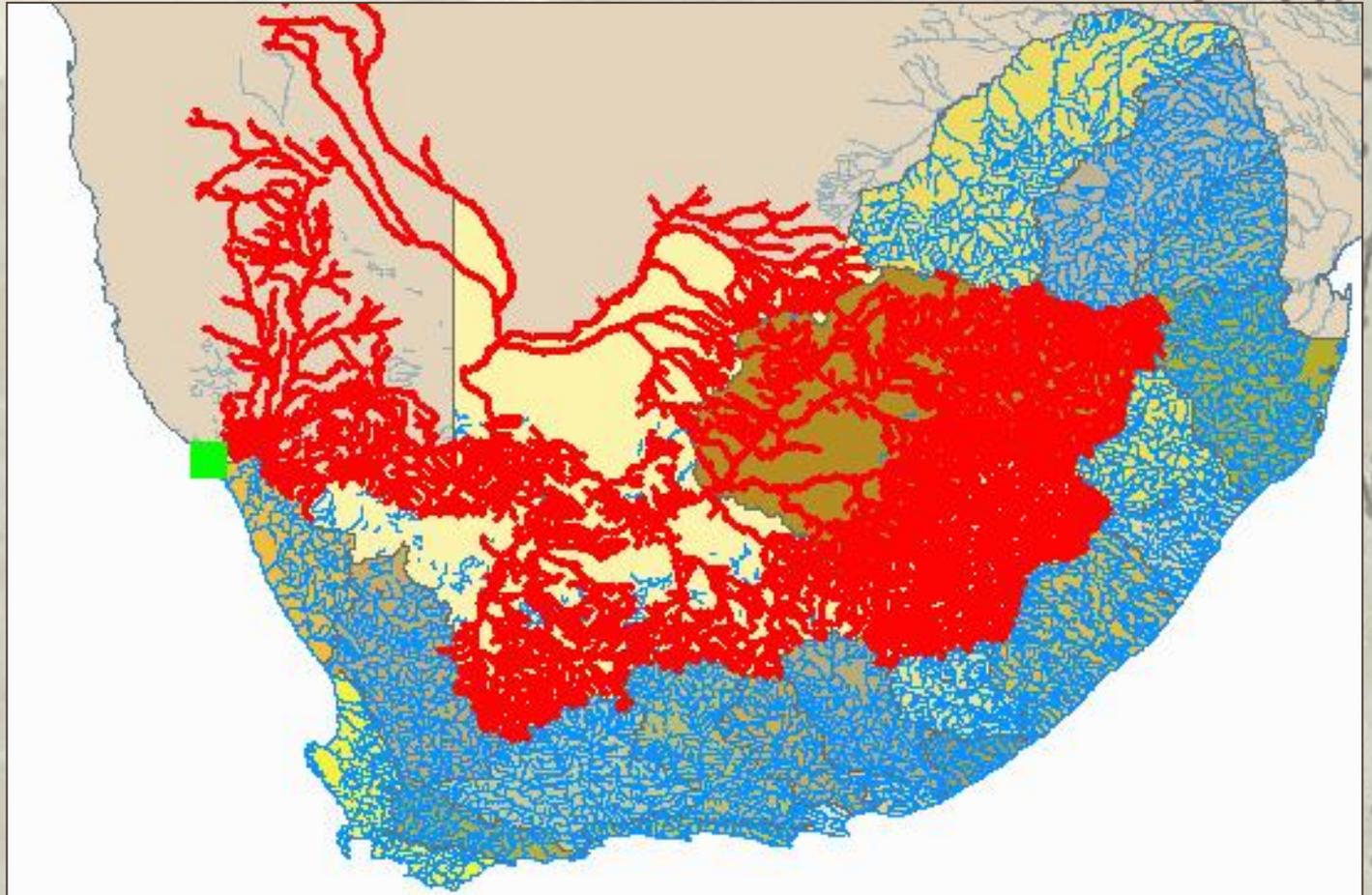


# A closer look at the geometric Network



# ArcHydro Network RSA

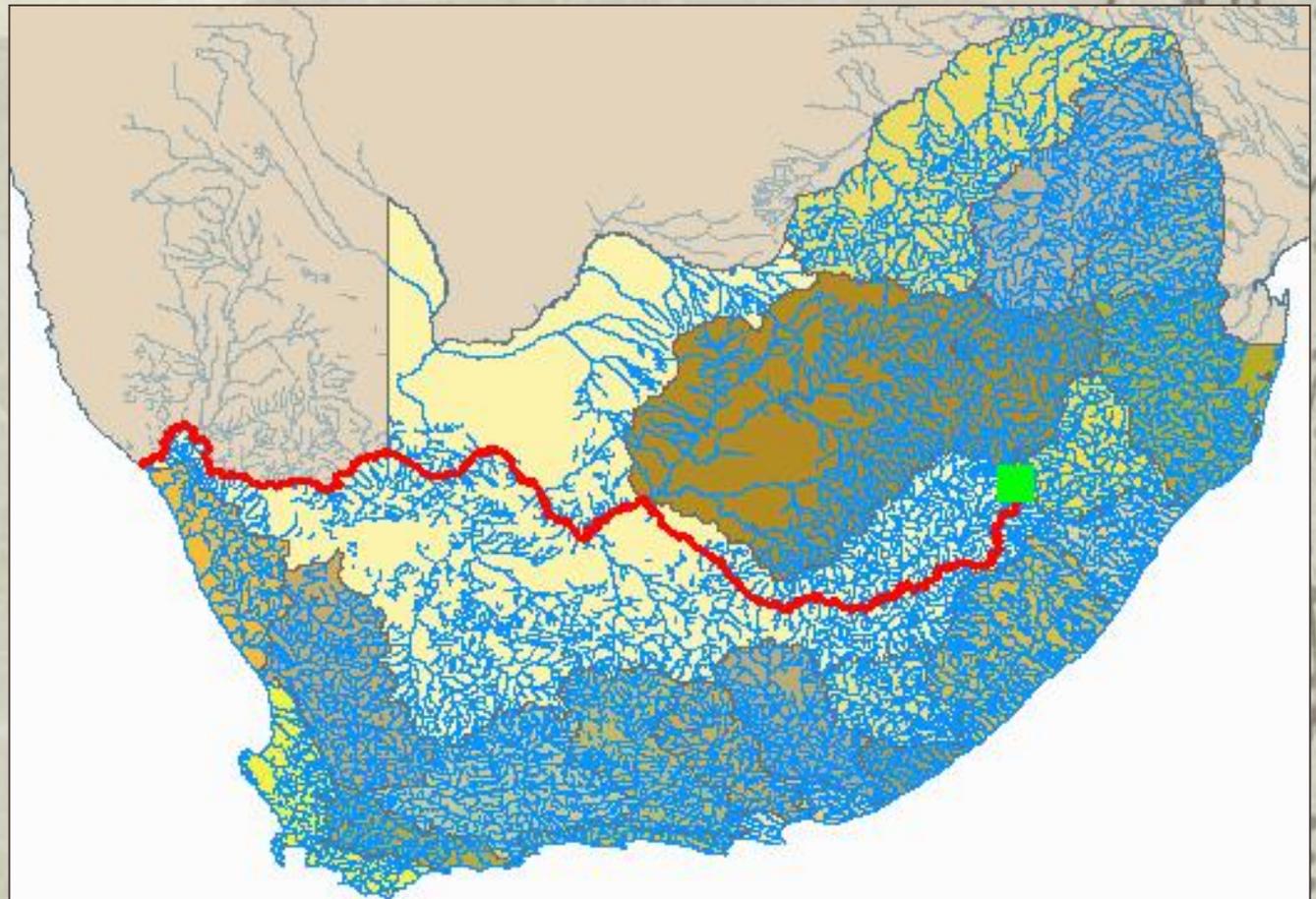
Trace Upstream the Orange River Mouth



# ArcHydro Network RSA



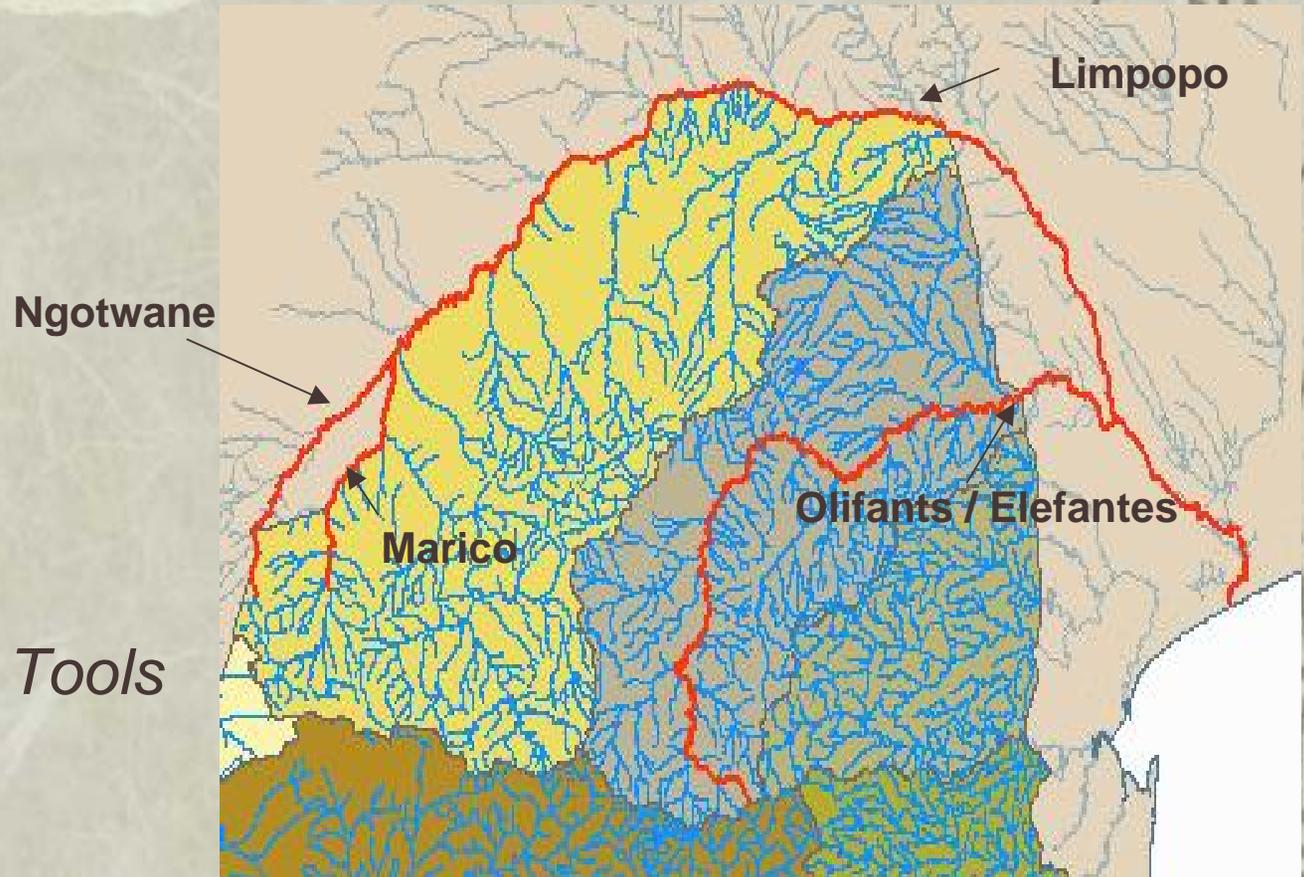
Trace Downstream the Orange River



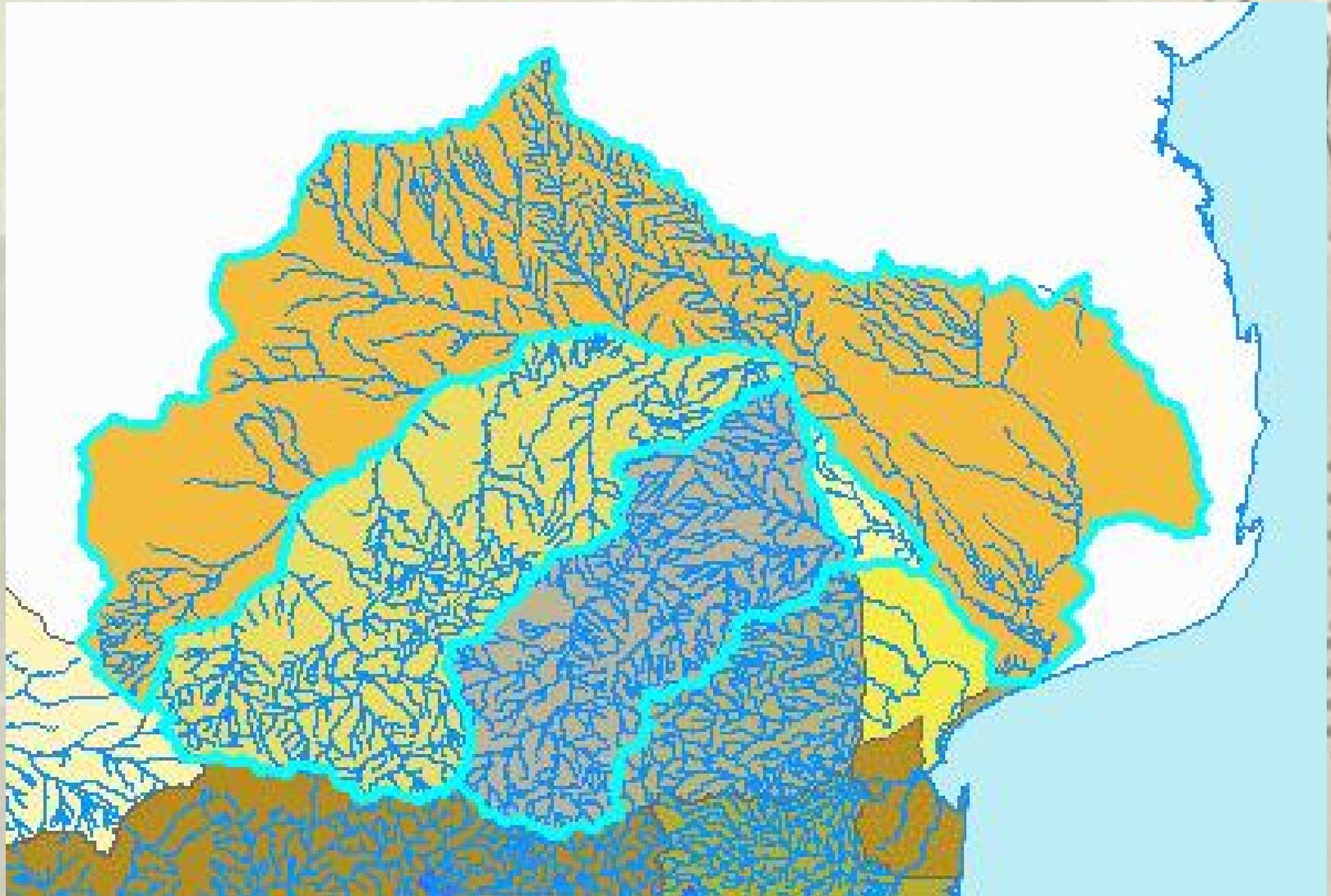
# Working with Geometric Network

Identify **Contamination** in the LIMPOPO Basins

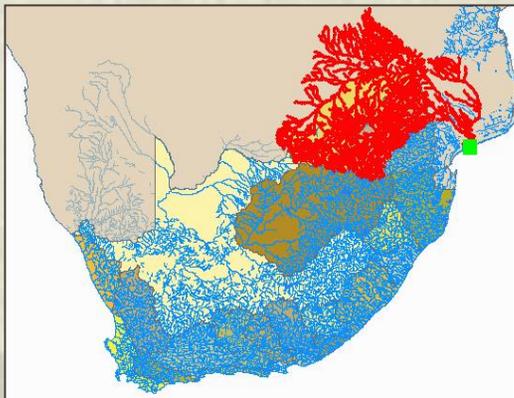
We use  
**ArcGIS** *Network Tools*



# Catchment Area's of the Limpopo Basins

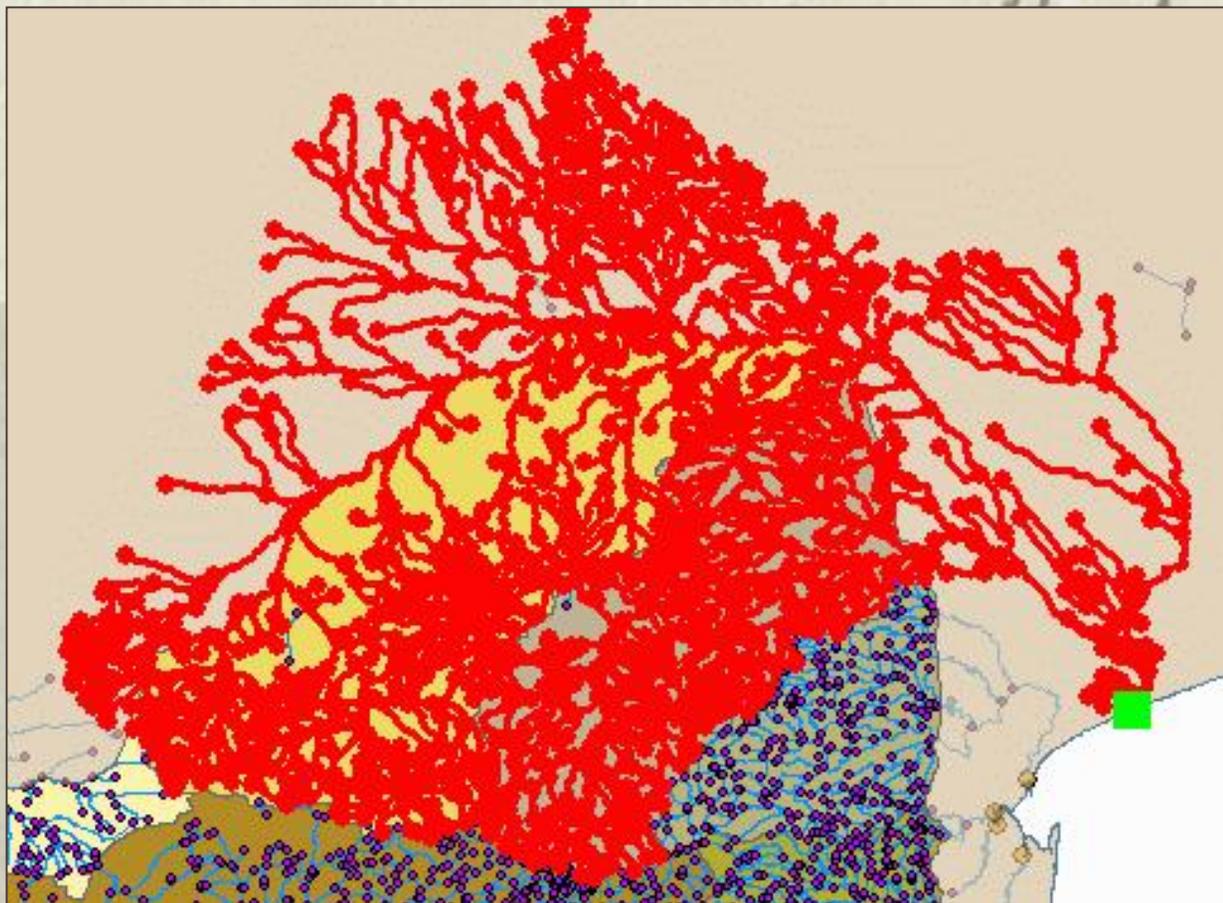


## Lets do a Trace Upstream from the sink at the bottom of Limpopo River



To perform a trace function, you must

- Add a junction flag tool
- Set the Trace Task as Trace Upstream
- Click the solve icon

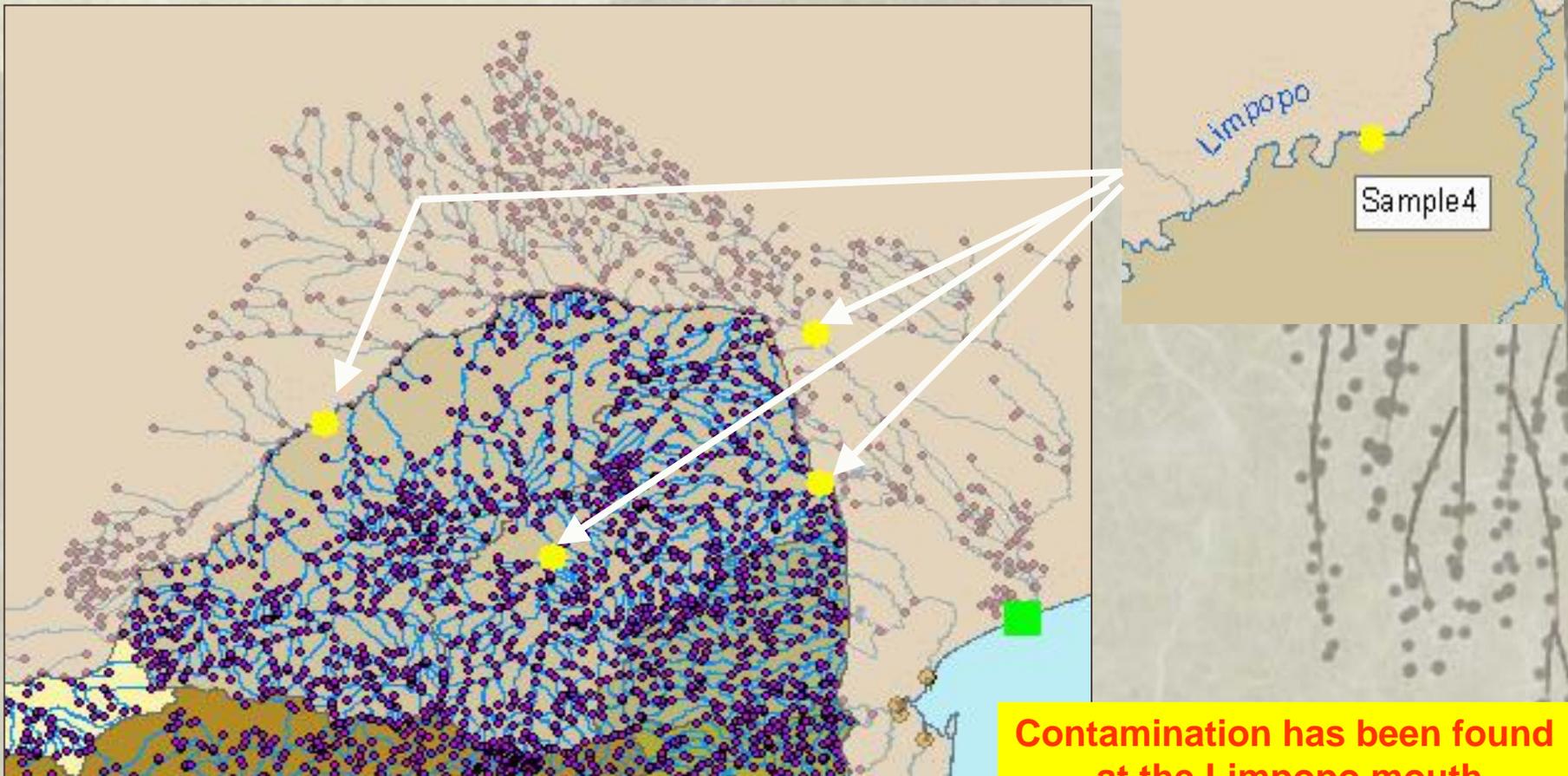


The trace found all the streams that flow into the ocean at this sink. You can see that all connected rivers were selected as the solution to the trace upstream from the position of the flag

# Pollution investigation

We'll narrow the search by ruling out those parts of the network that cannot be sources of the contamination.

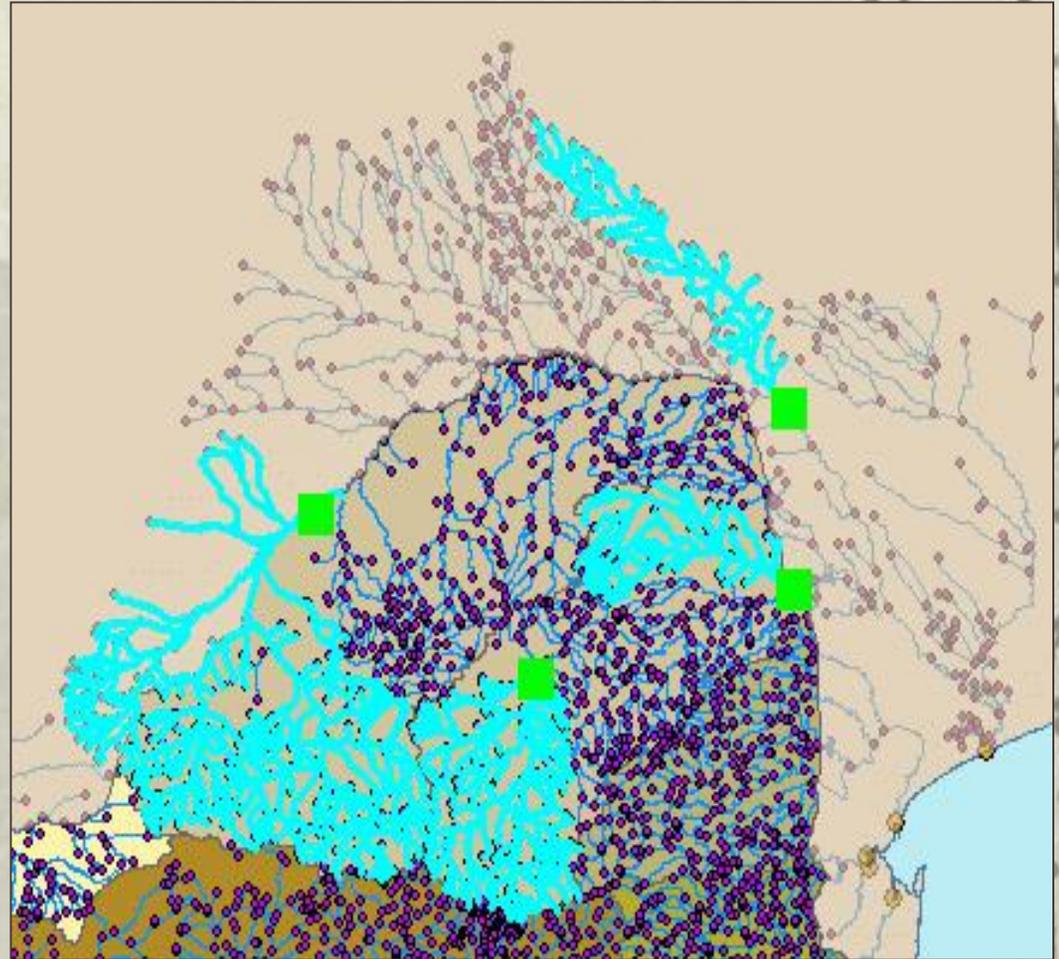
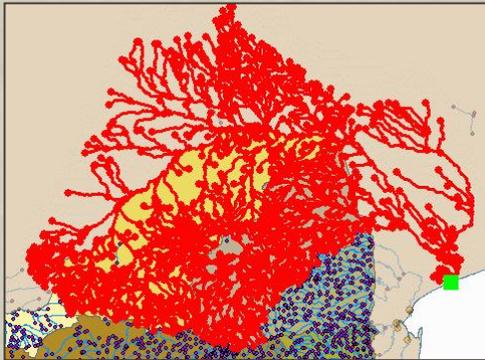
Data has been collected from four locations along the stream and **none** of the samples shows contamination.



Contamination has been found at the Limpopo mouth

# Pollution investigation

Click the **Add Edge Flag** tool  and place an edge flag on the edge specified by the green squares



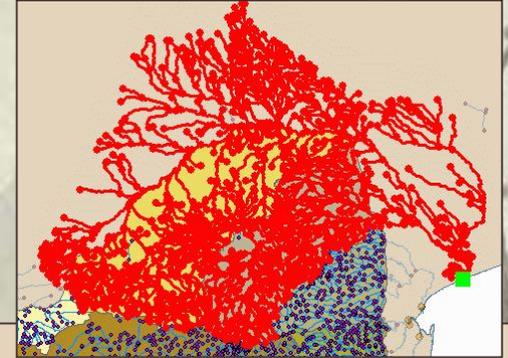
The Trace Upstream from the sample points shows the areas of the network that cannot be sources of pollution

All other parts of the watershed are potential sources of the contamination, so you could focus future field samples on the remaining stream segments

# Pollution investigation

To select possible sources of pollution we will trace just the **unselected** features.

These features could be sources of contamination because no samples have been taken in these areas.



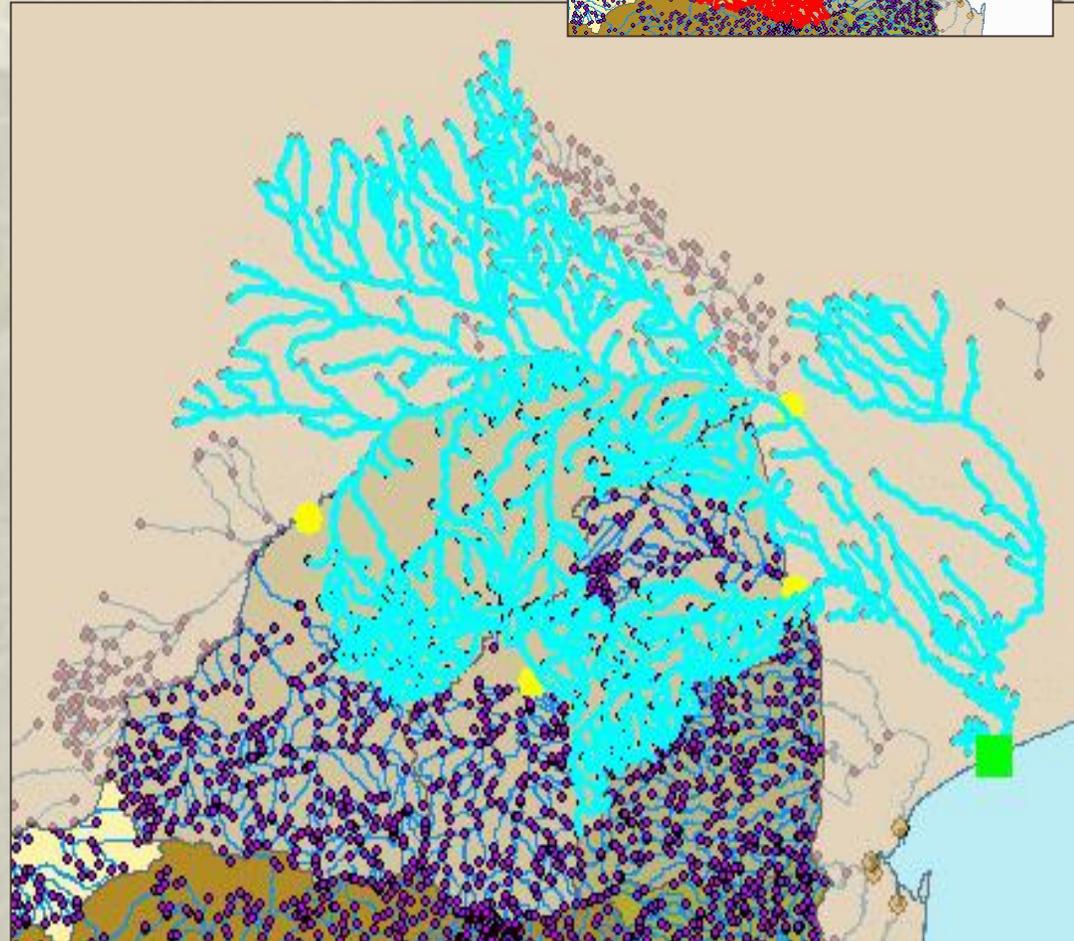
➡ **Clear Flags**

➡ **Place a Junction Flag on the sink at the bottom of Limpopo River**

➡ **From the Analysis menu, choose Options**

➡ **In the General tab, under Trace on, click Unselected features**

➡ **Click Solve button**



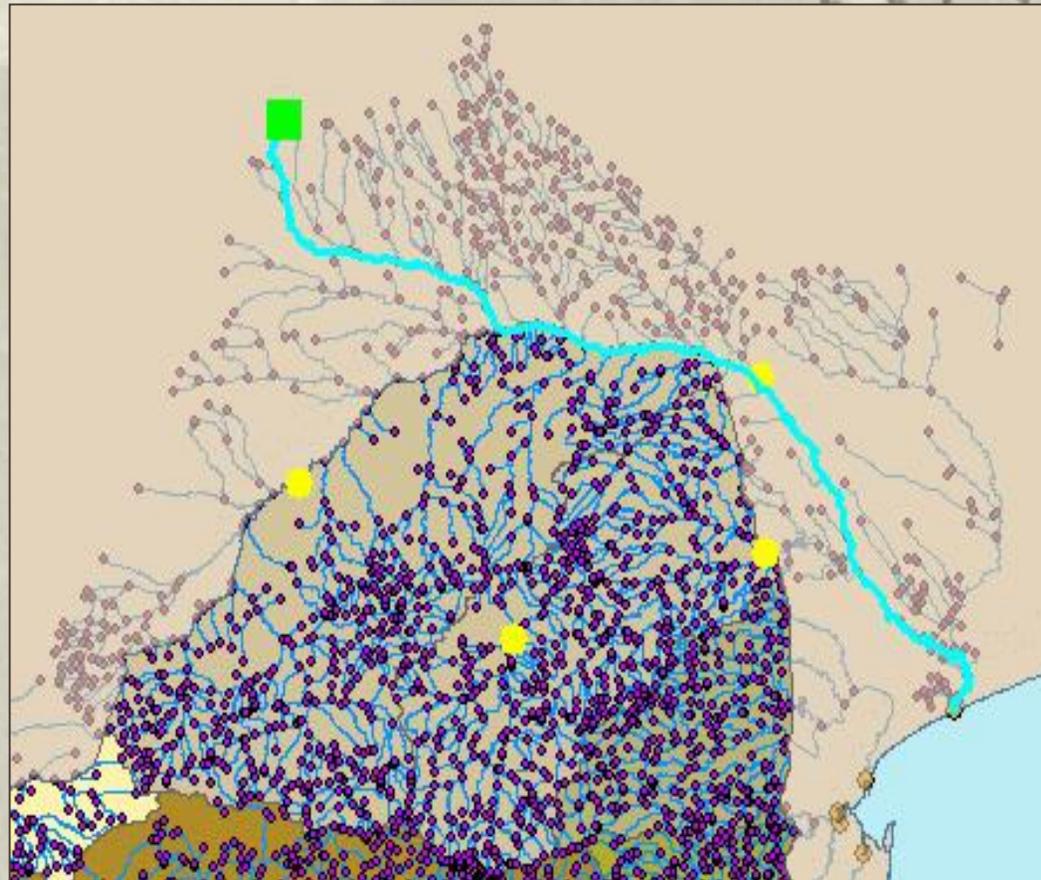
The trace result shows the streams where more samples should be taken

# Pollution investigation

**Find all streams that are contaminated.**

Guided by your network analysis, researchers have taken more water samples and have now determined exactly where the pollution is coming from.

- ➔ **Clear Selection and Flags**
- ➔ **Add a Junction Flag at the source of the pollution**
- ➔ **From the Trace Task drop down menu, choose Trace Downstream**
- ➔ **Click Solve button**



The Selected features indicate the locations where cleanup operations should be focused