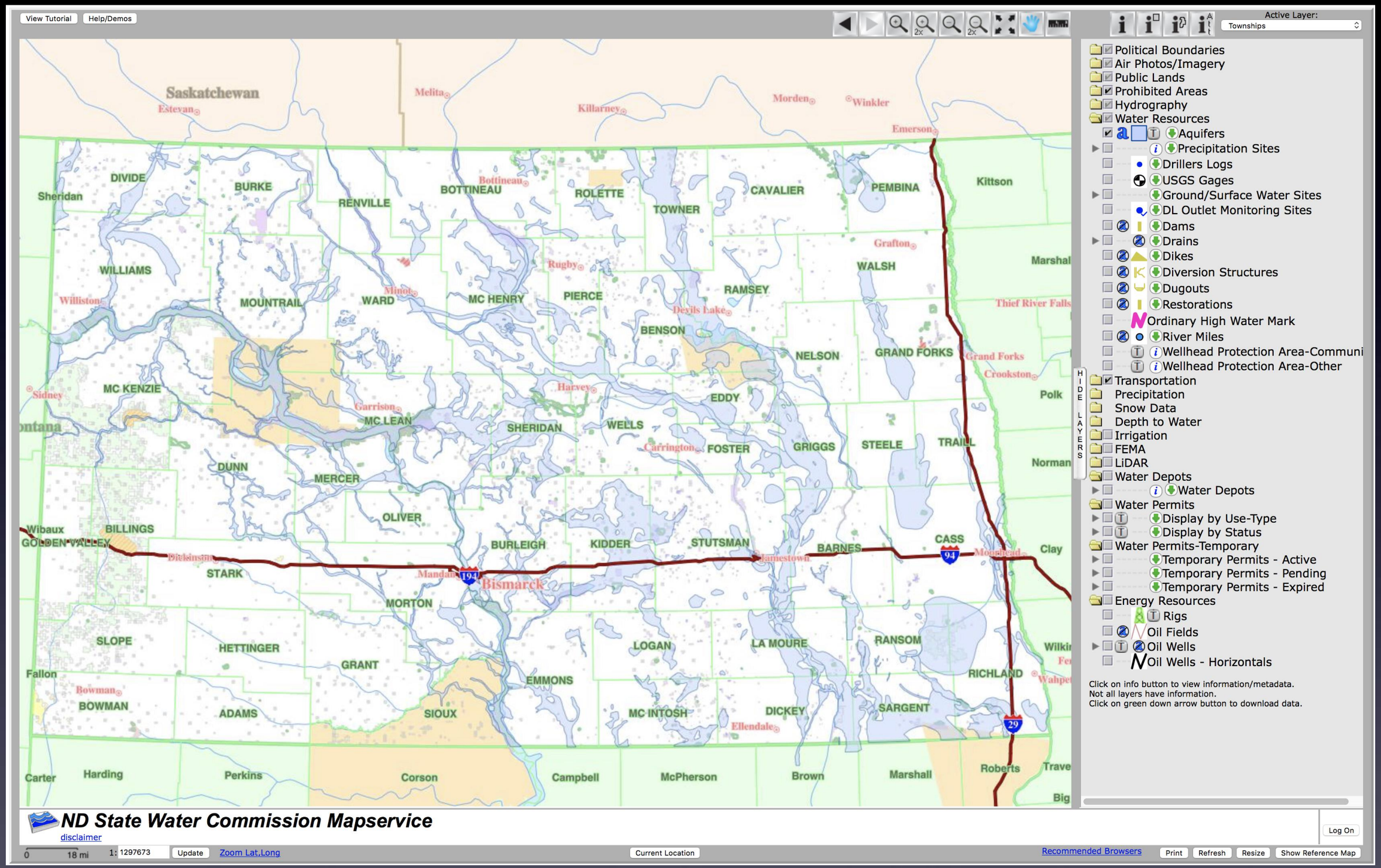
Leveraging Open Source to Minimize Risks associated with the Development and Maintenance of your Data Management Infrastructure

ND State Water Commission
Christopher D. Bader

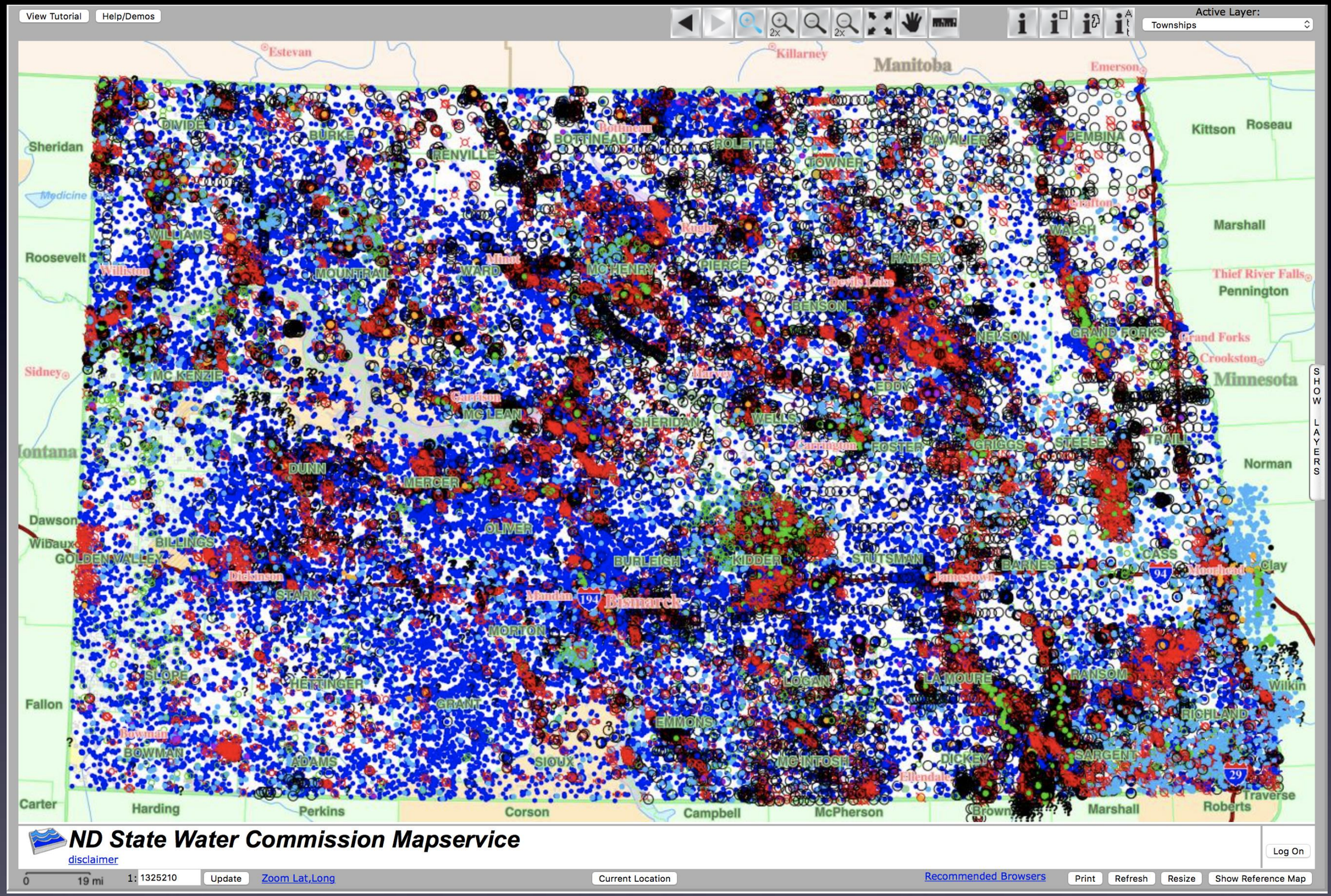
NDSWC Data Management Infrastructure



ND SWC Data Acquisition Efforts

- Earliest efforts in North Dakota date back to the early 1900's to record and maintain Water Permits for purposes of documenting established Water Rights.
- Cooperative efforts were coordinated with the USGS in the late 1940's to provide regional reconnaissance of North Dakota's ground-water resources.
- In the 1960's, Water Commission began large scale regional assessment program, which included the completion of more than 100,000 feet of exploratory drilling annually through much of the 1970's and 1980's.
- Data collection includes site information, subsurface information, water levels, and water chemistry with more than 100,000 sites distributed throughout North Dakota and more than 10,000,000 related data records.

NDSWC Data Management Infrastructure



NDSWC

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General Info

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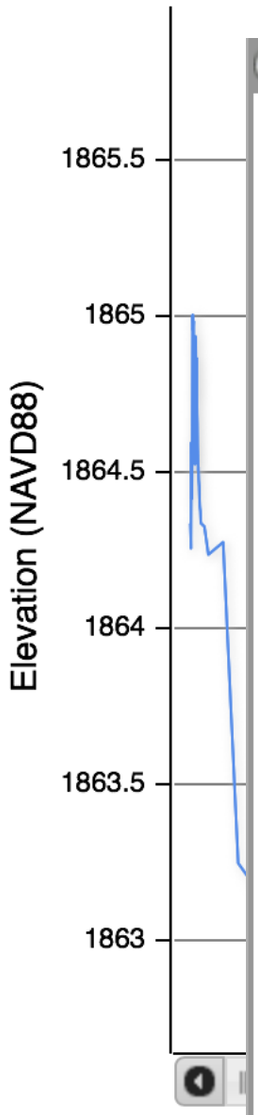

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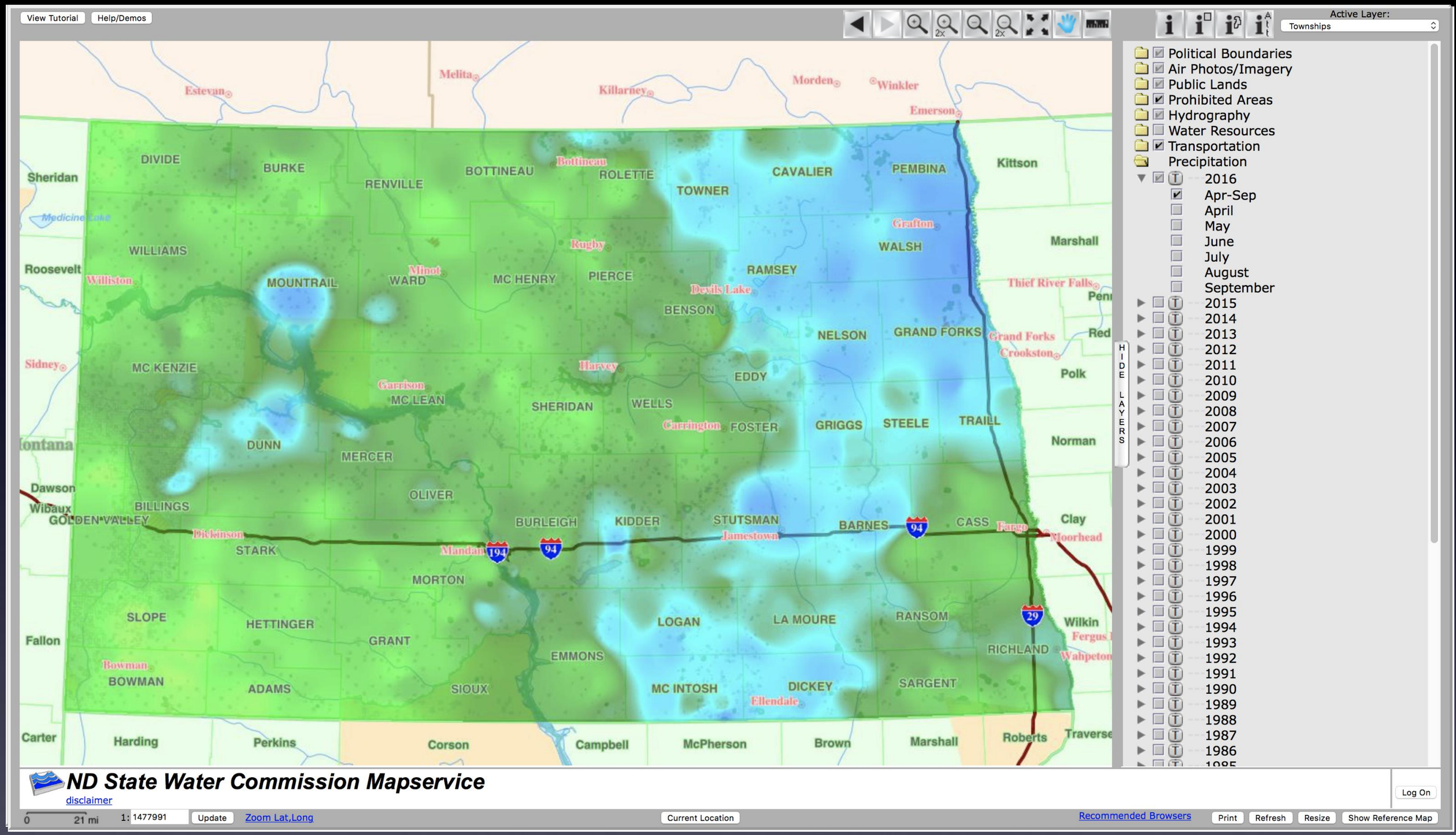
148-081-08 DAA (Datum NAVD88)

Date Measured	Time Measured	Measuring Point Elevation (ft)	Depth (ft) Below Measuring Point	Water Level Elevation (ft)	Data Source
1987-07-03	00:00:00	1876.93	12.59	1864.34	NDSWC
1987-07-06	00:00:00	1876.93	12.63	1864.30	NDSWC
1987-07-08	00:00:00	1876.93	12.67	1864.26	NDSWC
1987-07-10	00:00:00	1876.93	12.49	1864.44	NDSWC
1987-07-13	00:00:00	1876.93	12.33	1864.60	NDSWC
1987-07-15	00:00:00	1876.93	12.41	1864.52	NDSWC
1987-07-17	00:00:00	1876.93	12.51	1864.42	NDSWC
1987-07-20	00:00:00	1876.93	12.29	1864.64	NDSWC
1987-07-24	00:00:00	1876.93	11.92	1865.01	NDSWC
1987-07-27	00:00:00	1876.93	11.97	1864.96	NDSWC
1987-07-31	00:00:00	1876.93	11.94	1864.99	NDSWC
1987-08-03	00:00:00	1876.93	12.07	1864.86	NDSWC
1987-08-05	00:00:00	1876.93	12.12	1864.81	NDSWC
1987-08-07	00:00:00	1876.93	12.24	1864.69	NDSWC
1987-08-10	00:00:00	1876.93	12.33	1864.60	NDSWC
1987-08-12	00:00:00	1876.93	12.40	1864.53	NDSWC
1987-08-18	00:00:00	1876.93	11.99	1864.94	NDSWC
1987-08-19	00:00:00	1876.93	12.00	1864.93	NDSWC
1987-08-21	00:00:00	1876.93	12.09	1864.84	NDSWC
1987-08-24	00:00:00	1876.93	12.19	1864.74	NDSWC
1987-08-26	00:00:00	1876.93	12.06	1864.87	NDSWC
1987-08-28	00:00:00	1876.93	12.11	1864.82	NDSWC
1987-08-31	00:00:00	1876.93	12.24	1864.69	NDSWC
1987-09-02	00:00:00	1876.93	12.27	1864.66	NDSWC

Ca

Mercury (ug/l)
Arsenic (ug/l)
Strontium (ug/l)
Cadmium (ug/l)

NDSWC Data Management Infrastructure

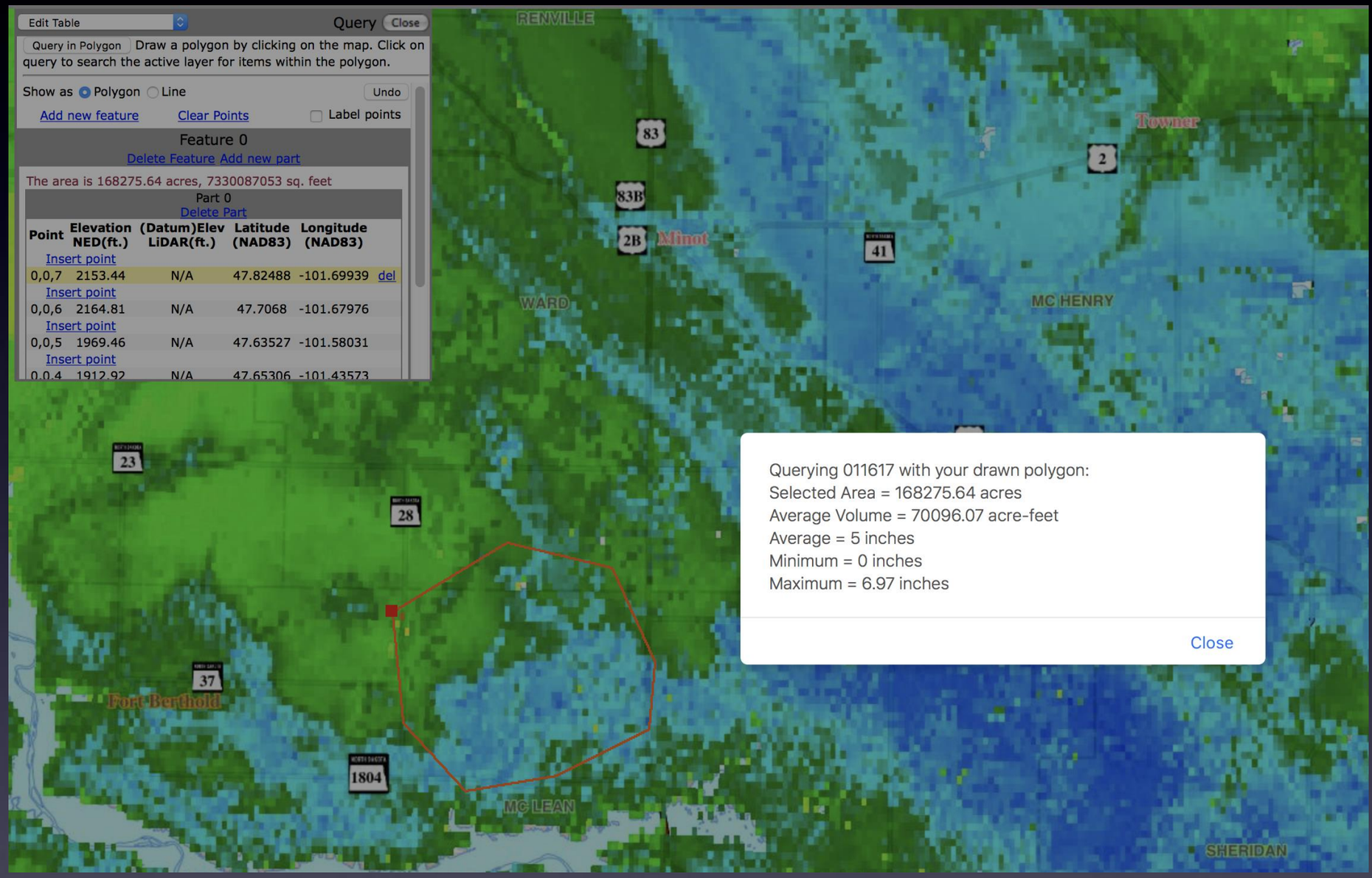


Statewide Precipitation Data (1977 to present)

ND SWC Data Acquisition Efforts

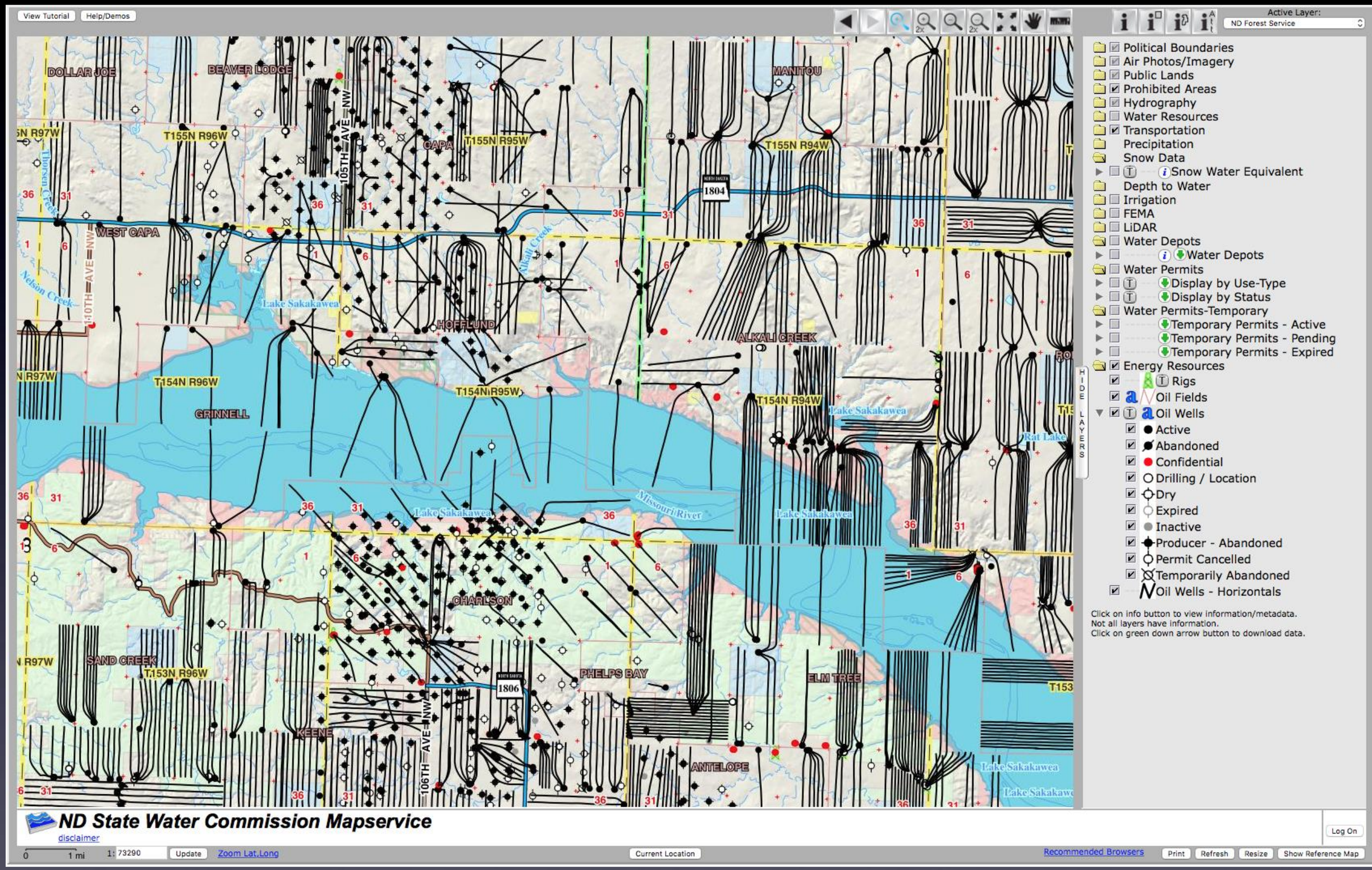
- Collection, Inventory, and permitting of retention structures (Dams, Dykes, Diversion Structures, etc), and Drains throughout the state.
- Atmospheric data collection which includes precipitation, snow and hail.
- Extensive aerial image resources with more than 1,000,000 historical photos including black & white, color, and color-infrared dating back to the 1930's. 700,000 of these have already been scanned and more than 250,000 are geo-registered and available on-line.
- GLO Land Plats with original Public Land Survey notes and data from the late 1800's.
- Extensive LiDAR resources with statewide coverage.

NDSWC Data Management Infrastructure

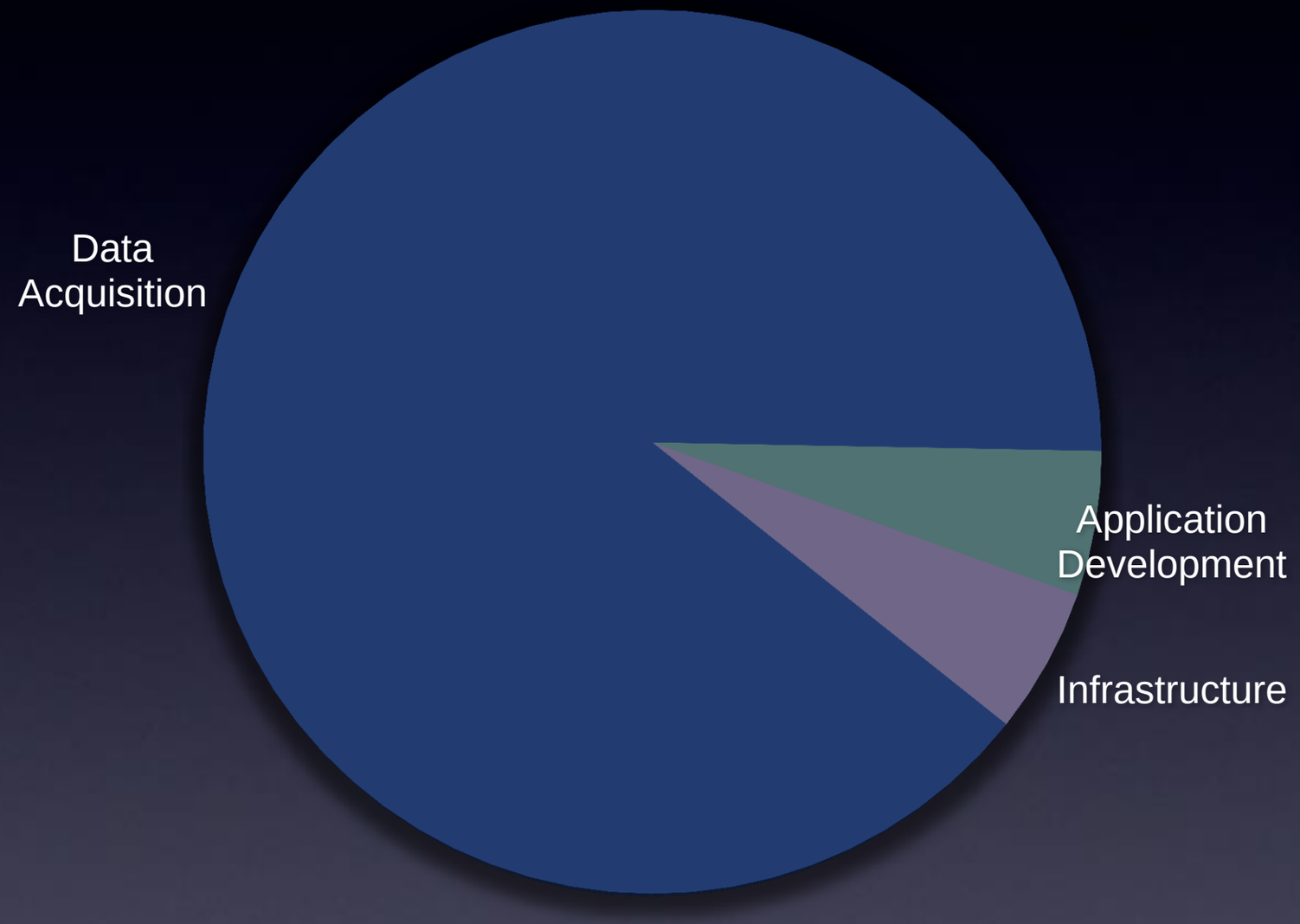


Snow Data Assimilation System (SNODAS)
Snow Water Equivalent

NDSWC Data Management Infrastructure



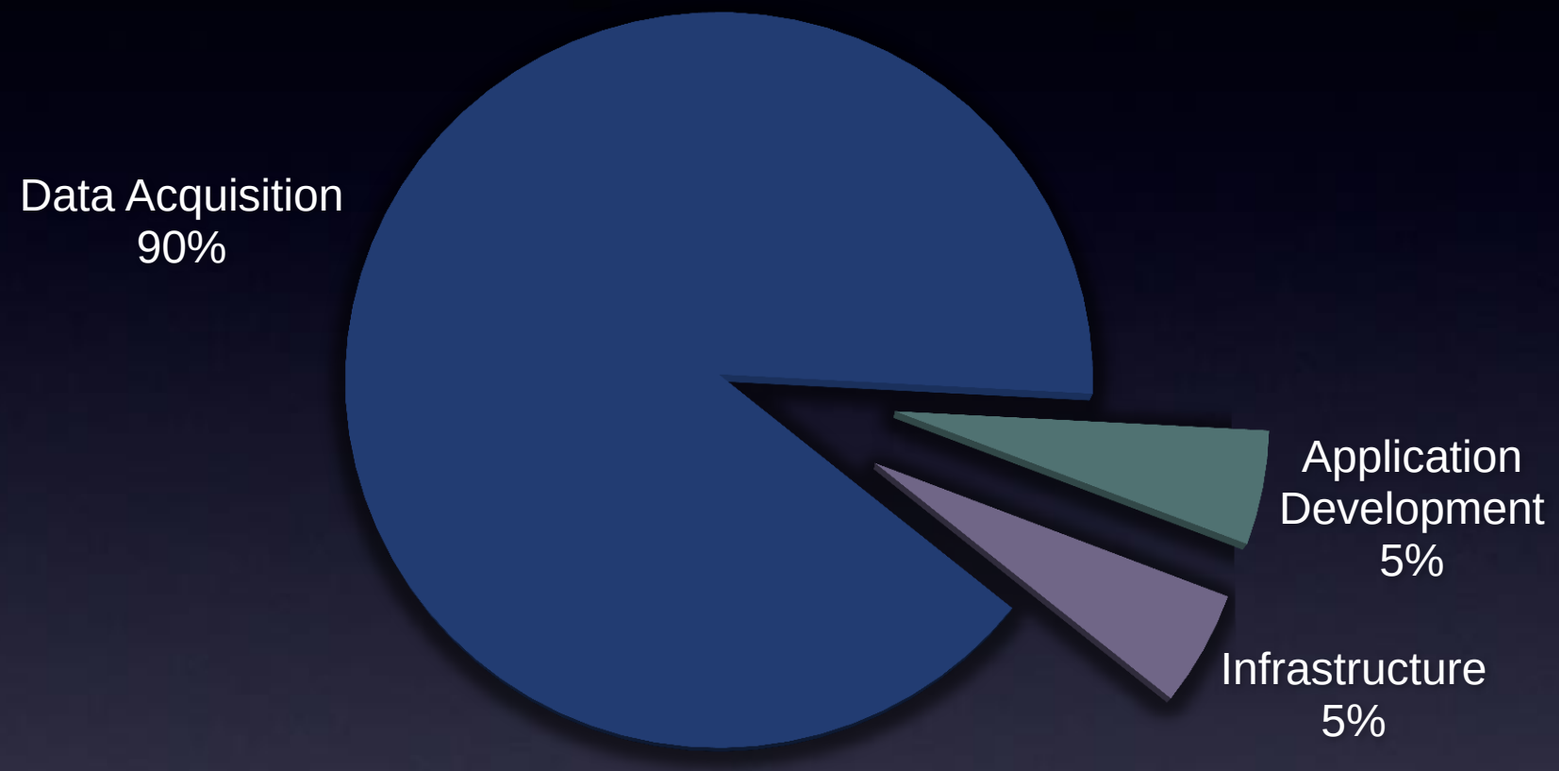
Components of a Data Management Program



Developing a Data Management Infrastructure

- The development of data management systems are costly - particularly those that require spatial and temporal management and analysis.
- Focus tends to be on technology costs not the overall costs associated with developing the data or the resulting services.
- Technology becomes even more significant when on-going funding is required to support the project.
- In the end, technology costs often dictate the success and failure of data management solutions even though it represents a minor component of overall cost associated with your data or your management operation.

Components of a Data Management Program



Based upon our Experience, the on-going funding associated with the Infrastructu
presents the greatest vulnerability for our data management initiatives

Developing a Data Management Infrastructure

- The NDSWC has developed a comprehensive integrated spatially-enabled water resource management solution.
- All of these services are displaying data that is live and tied to active management systems.
- Supports Standard Web Services, WFS, WMS, SOAP, REST, JSON, XML, etc.
- Also supports a number of proprietary services for internal data delivery.
- And as you may have guessed, this infrastructure is entirely based upon Open-Source Solutions.

Integrated Open Source Solutions

MapServer
open source web mapping

QGIS
Trademark

PostGIS

GDAL

PostgreSQL

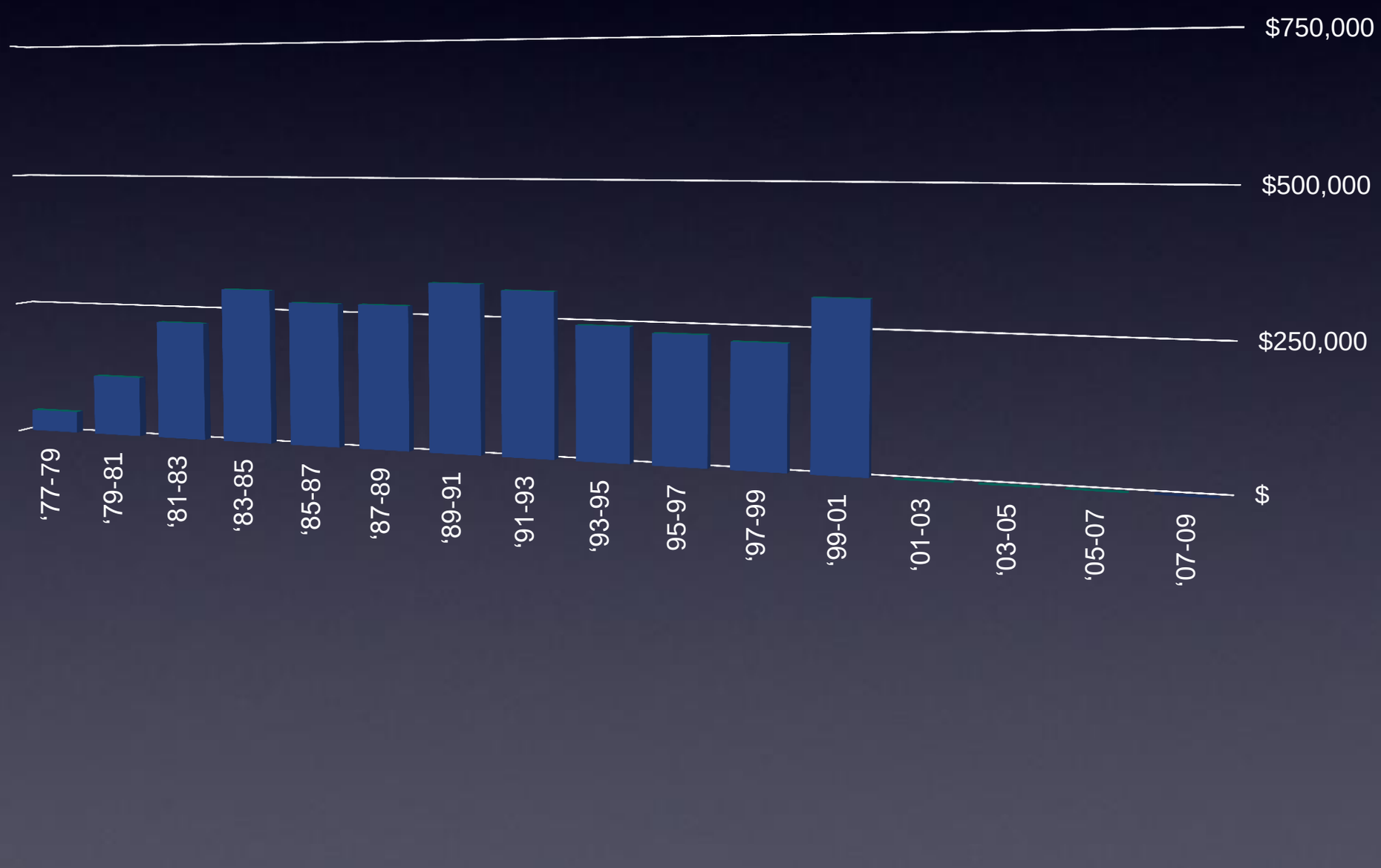
OSGeo
Code Sprint

SWC IT History

However, Open Source is not where we started . . . . .

- Implemented VSAM files on IBM Mainframe (early 1980’s)
- Began using spatial data in the late 1980’s (Displa, Fortran, Telegraph)
- Much of the spatial base data originated with the REAP project (late 1970’s)
- 1991 began using MapInfo (Stand-alone)
- 1993 Grass and Informix introduced (began to look at integration)
- 1994 Implemented ArcView (Stand-alone, experimented with different integration options, Avenue, AppleScript, AppleEvents, ODBC)
- 1999 developed GIS requirements and associated strategic plan to implement the next generation management infrastructure.

Historic IT Expenditures



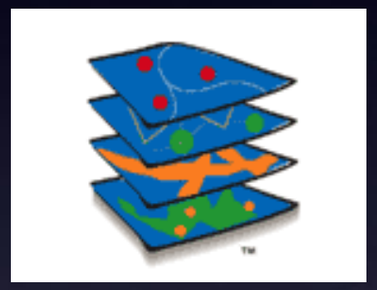
Proposed Tools for Spatial Infrastructure

esri

ArcSDE

ArcIMS

ArcView



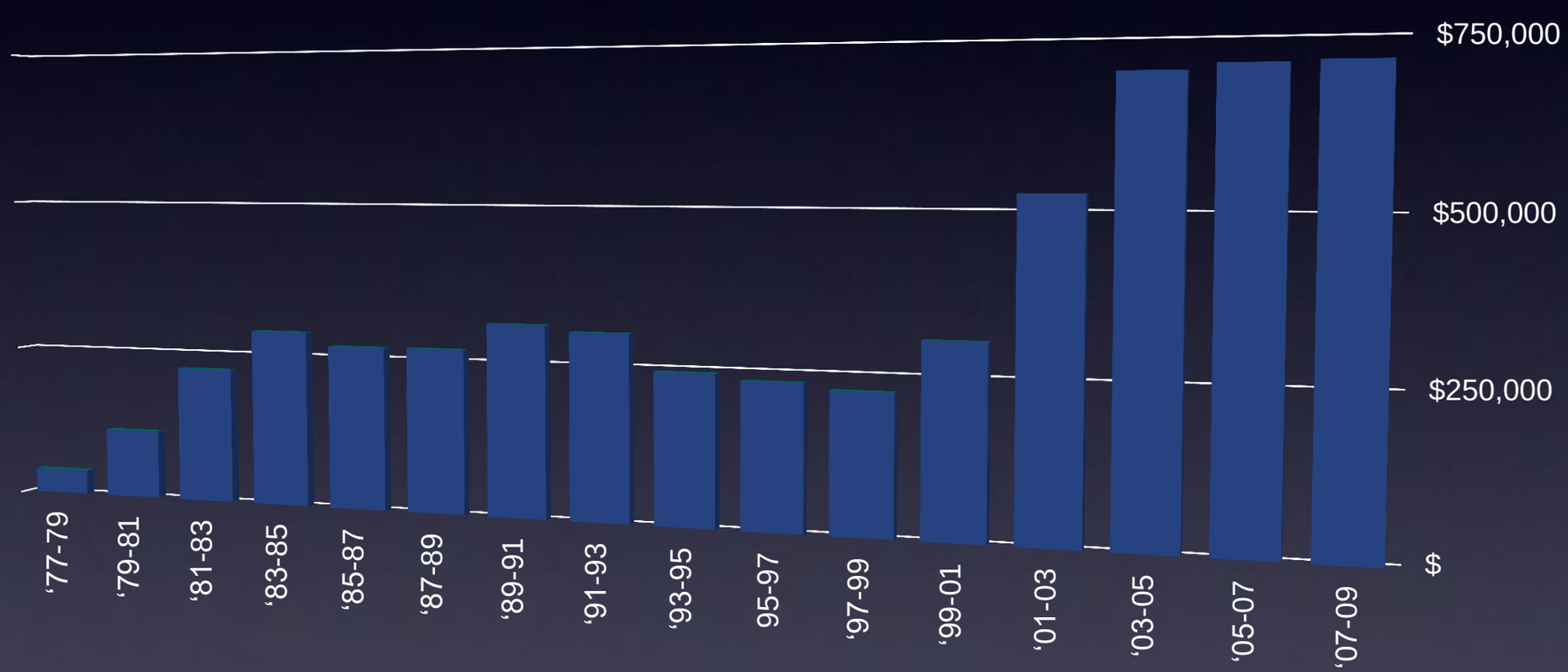
ArcInfo

Microsoft SQL Server

ORACLE

Projected IT Budget Requirements (01-09)

The implementation of the new infrastructure was to occur in two phases . . .



Project Implementation

The implementation of the new infrastructure was to occur in two phases . . .

The first phase was to include . . .

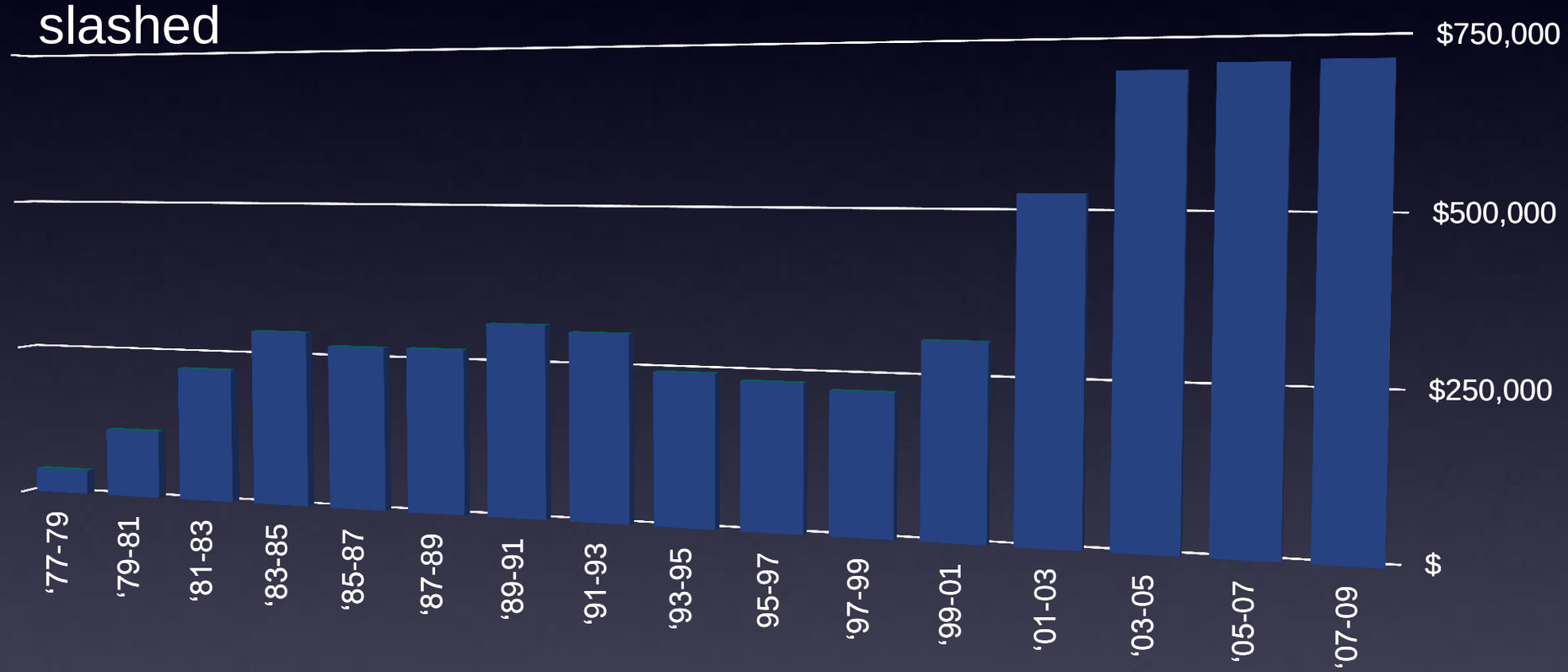
- Building the spatial data management infrastructure (ArcSDE, ArcIMS, MS SQL Server)
- Acquisition of the core client applications (i.e. ArcMap, ArcView, etc)
- End-user training
- Development of the core applications (spatial editing, versioning, etc.)
- Bridging the spatial data management and legacy aspatial systems (ODBC, SQL)

The second phase was to include . . .

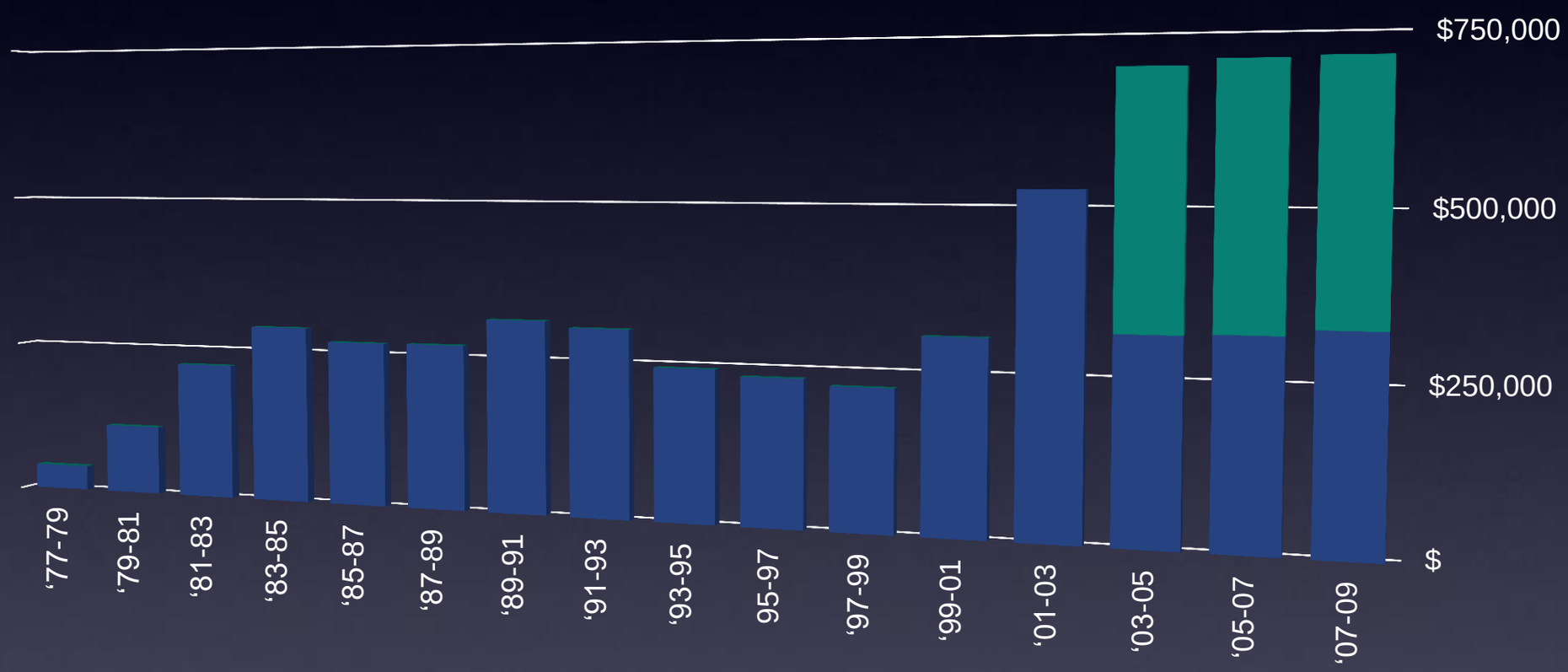
- Migrating the database infrastructure from MS SQL Server to Oracle
- Expanding the server licensing to accommodate all users
- Expansion of the client application licenses (i.e. ArcMap, ArcView, etc)
- General Deployment (End-user training, etc.)

Actual IT Funding

- 01-03 Budget was funded
- The first phase of deploying the spatial infrastructure was completed
- Budget guidelines for 03-05 Biennium included a 95% base budget
- Budget increases related to IT were viewed as a liability and were slashed



Funding Gap


$750,000
$500,000
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'01-03
'03-05
'05-07
'07-09

Reality Check

- Drop Maintenance on ESRI & MS SQL server
- Resume management role of many legacy systems.
- Forced us to step back and review our data infrastructure and re-evaluate our options
- At this time, Open Source Solutions for Desktop GIS were somewhat anemic (QGIS was at version 0.7)
- However, the promise of what QGIS has since become was evident

Common Open Source Myths

- Open Source has a much higher knowledge threshold to deploy and maintain.
- Commercial Solutions were easier to support with better maintenance and support channels.
- Commercial Solutions provide more depth and variety to deploy complex management solutions.

Current State

- Total management infrastructure costs have been reduced to simple hardware costs.
- Current Savings include more than $200,000 in annual software and maintenance costs
- While our infrastructure costs are still subject to the same budget problems, it is much easier to extend the life of the hardware, etc to accommodate budget shortfalls, etc.