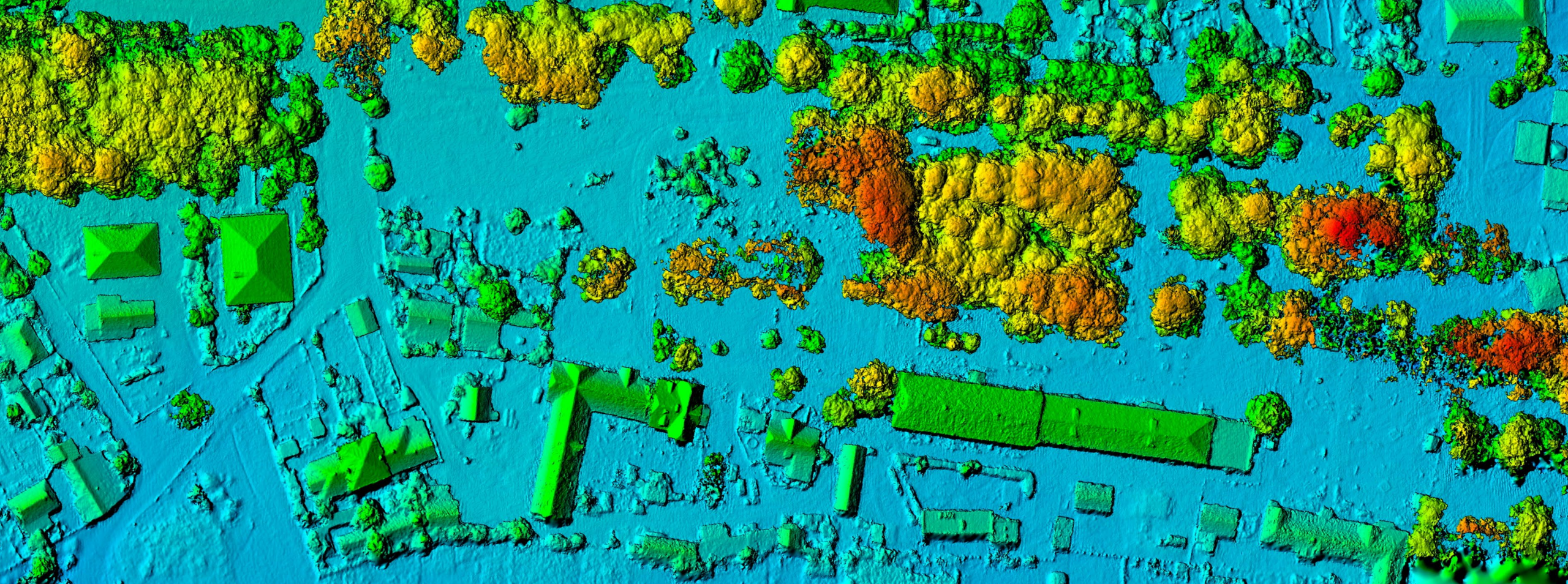




TMPD Workshop Introduction to GIS

Saskatoon, February 12th & 13th 2020





Intro to GIS

- What is GIS?
- Essential elements of GIS
- Examples of GIS Programs
- Planning for GIS
- Integrated Planning with GIS

What is GIS?

A system of **hardware, software, and procedures** used to facilitate the management, manipulation, analysis, modelling, representation, display, interpretation and reporting of **georeferenced data** to solve complex problems regarding **planning and management of resources**.

Who uses GIS?



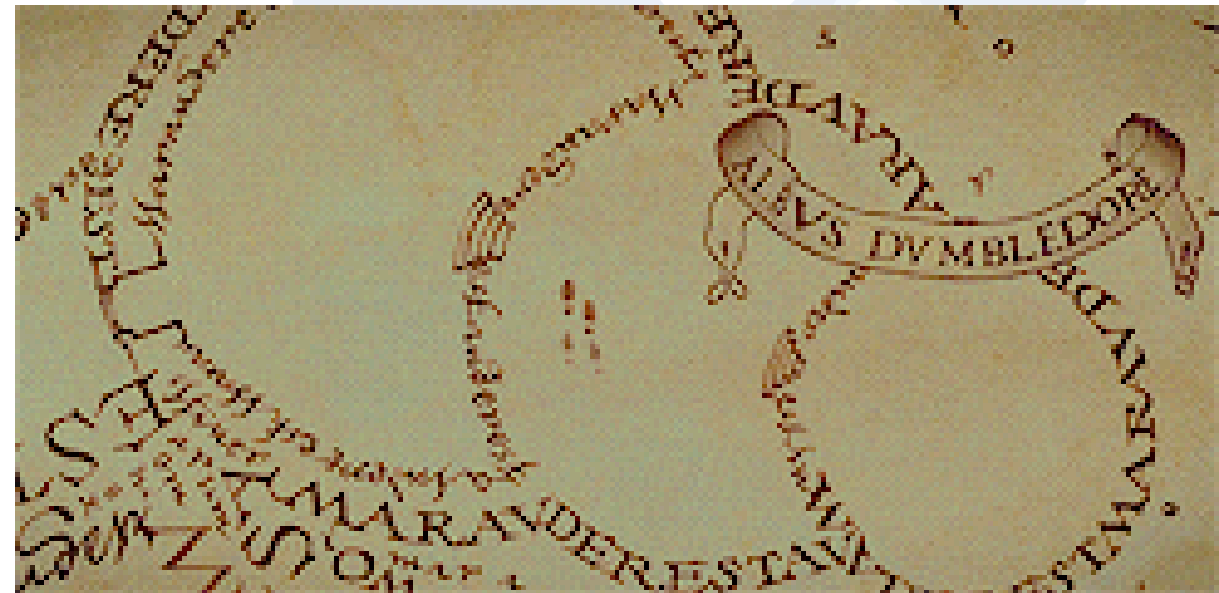
GPS vs GIS

Global Positioning System (GPS)

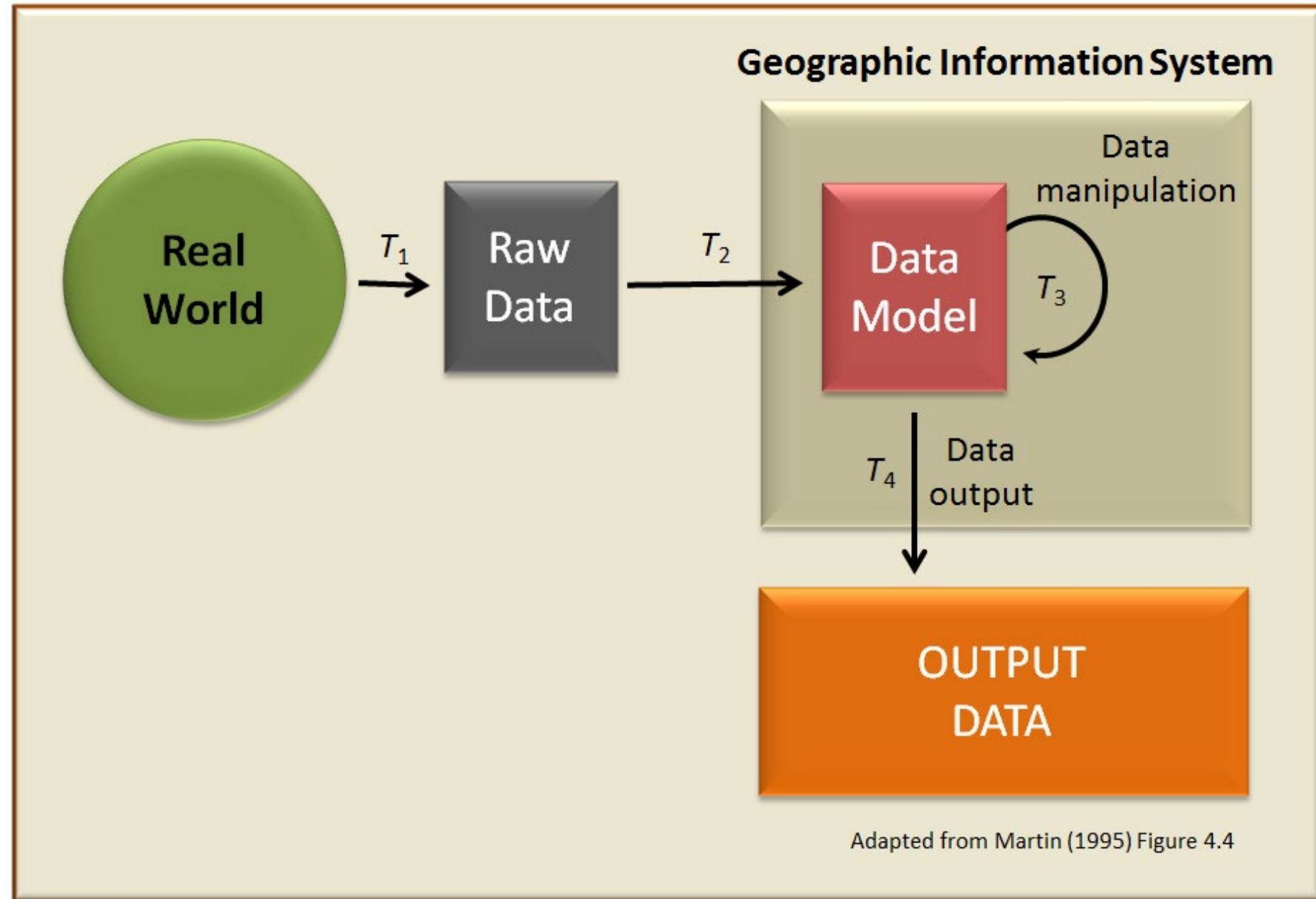
Reference to technology, including satellites and hand-held GPS devices. These are used to pinpoint an exact location on Earth. GPS is useful for:

- Locating positions
- Emergency Services
- Mapping and Surveying

GPS information is an example of spatial data that can be imported into a Geographic Information System (GIS). GIS can be used to store, access, analyze, and display GPS data.



GIS Model



What are the essential ingredients of GIS?



Essential Ingredient #1:

GIS Hardware

The physical equipment needed to operate GIS:

- Desktop computer
- Laptop computer
- Mobile Devices
- Garmen, Trimble, other hand-held GPS devices.
- Plotter
- Surveying Equipment



Essential Ingredient #2:

GIS Software is designed to store, retrieve, manage, display, and analyse all types of geographic and spatial data. **GIS software** lets you produce maps and other graphic displays of geographic information for analysis and presentation.

QGIS – free, open source GIS software



GIS Software

Notable commercial or proprietary GIS software [\[edit \]](#)

Desktop GIS [\[edit \]](#)

Note: Almost all of the companies below offer Desktop GIS and WebMap Server products. Some such

Companies with high market share [\[edit \]](#)

- [Autodesk](#) – Products that interface with its flagship [AutoCAD](#) software package include [Map 3D](#), [Tri](#)
- [Bentley Systems](#) – Products that interface with its flagship [MicroStation](#) software package include
- [ENVI](#) – Utilized for image analysis, exploitation, and hyperspectral analysis.
- [ERDAS IMAGINE](#) by [ERDAS Inc](#) – Products include [Leica Photogrammetry Suite](#), [ERDAS ER Ma](#) and [ERDAS APOLLO](#).
- [Esri](#) – Products include [ArcMap](#), [ArcGIS](#), [ArcSDE](#), [ArcIMS](#), [ArcWeb](#) services and [ArcGIS Server](#).
- [Intergraph](#) – Products include [G/Technology](#), [GeoMedia](#), [GeoMedia Professional](#), [GeoMedia WebI](#)
- [MapInfo](#) by [Pitney Bowes Software](#) – Powerful desktop GIS [MapInfo Professional](#) is enhanced with
- [Smallworld](#) – developed in Cambridge, England ([Smallworld, Inc.](#)) and purchased by [General Elec](#)

Companies with minor but notable market share [\[edit \]](#)

- [Cadcorp](#) – Products include [Cadcorp SIS](#), [GeognoSIS](#), [mSIS](#) and developer kits.
- [Caliper](#) – Products include [Maptitude](#), [TransModeler](#) and [TransCAD](#).
- [Conform](#) by [GameSim](#) – Software for fusing and visualizing elevation, imagery, vectors, and [LiDAR](#)
- [Dragon/lps](#) – Remote sensing software with GIS capabilities.
- [Geosoft](#) – GIS and data processing software used in [natural resource exploration](#).
- [GeoTime](#) – software for 3D visual analysis and reporting of location data over time; an [ArcGIS exte](#)
- [Global Mapper](#) – GIS software package currently developed by [Blue Marble Geographics](#); original
- [Golden Software](#) – GIS and scientific software for a wide variety of professional geological applica
- [Voxelr](#) for true 3D well and component mapping, [Didger](#) for digitizing and coordinate conversion, a
- [Kongsberg Gallium Ltd.](#) – Products include [InterMAPhics](#) and [InterView](#). High performance GIS vie
- [MapDotNet](#) – Framework written in [C#/ .NET](#) for building [WPF](#), [Silverlight](#), and [HTML5](#) applications
- [Manifold System](#) – GIS software package.
- [CitySurf Globe](#) – Server based 3D GIS software, developed by [PiriReis](#).
- [RegioGraph](#) by [GfK GeoMarketing](#) – GIS software for business planning and analyses; company a
- [RemoteView](#) by [Overwatch](#) – [RemoteView](#) is one of the most widely used imagery analysis tools v
- [SuperMap Inc.](#) – a professional GIS software provider that offers Desktop, Component, Web, and
- [TerrSet](#) (formerly [IDRISI](#)) – GIS and Image Processing product developed by [Clark Labs](#) at [Clark U](#)
- [TNTmips](#) by [MicrolImages](#) – a professional system integrating desktop GIS, advanced image proc

Essential Ingredient #3: **Geo-Referenced Data**

Also known as 'Spatial Data'

Any type of data that has a location on the surface of the Earth associated with it, such as:

- Point/location of an object, place, or feature
- An area (City, Forest, Park, Neighborhood)



Essential Ingredient #3: **Geo-Referenced Data**

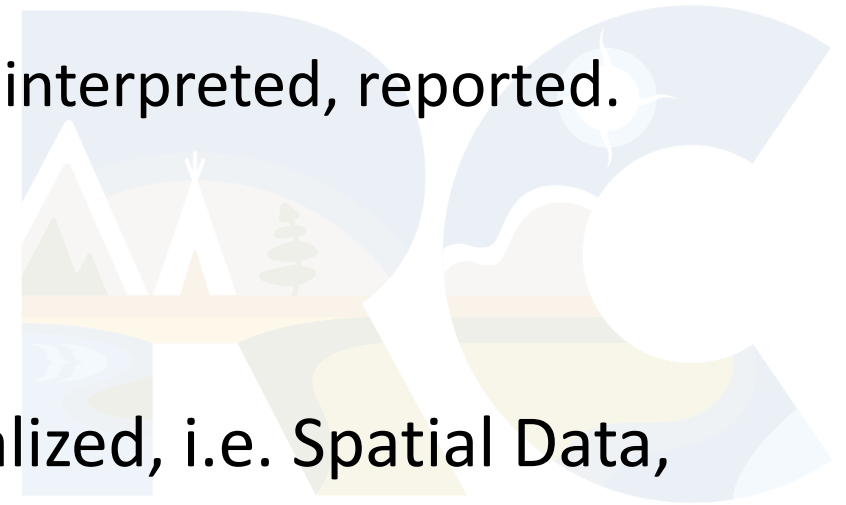
What do we mean by 'data'?

Individual units of Information about the world around us. Contextual.

Information that is measured, collected, analyzed, interpreted, reported.

Information that can be visualized.

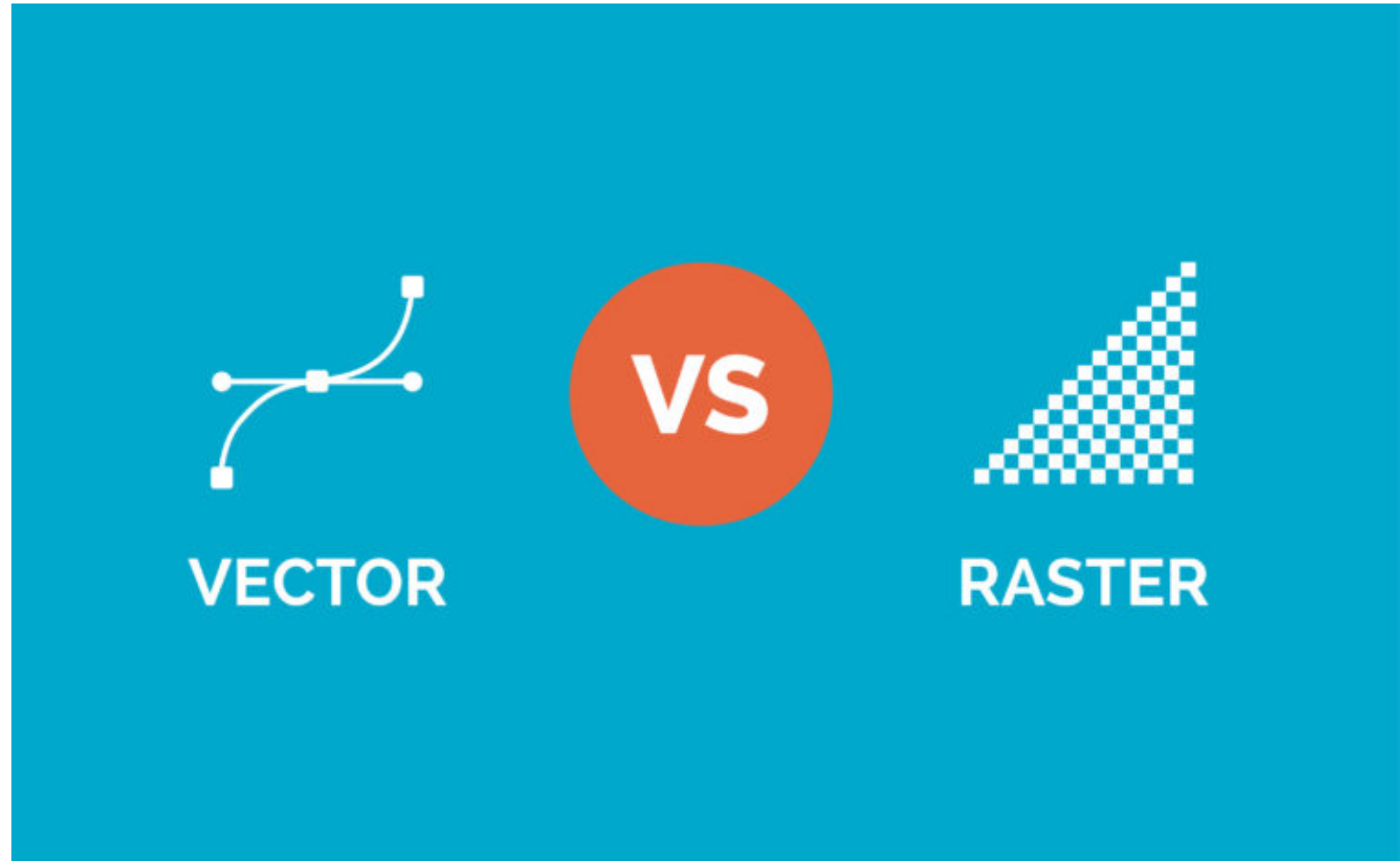
In a GIS context, information that can be Spatialized, i.e. Spatial Data, Geo-referenced data.



Essential Ingredient #3: **Geo-Referenced Data**

Vector vs Raster Data

- Spatial data provides information about the real world that a GIS uses to reconstruct in a representational form (e.g. on a screen)
- Raster data makes use of grid cells.
- Vector data uses points, lines and polygons.

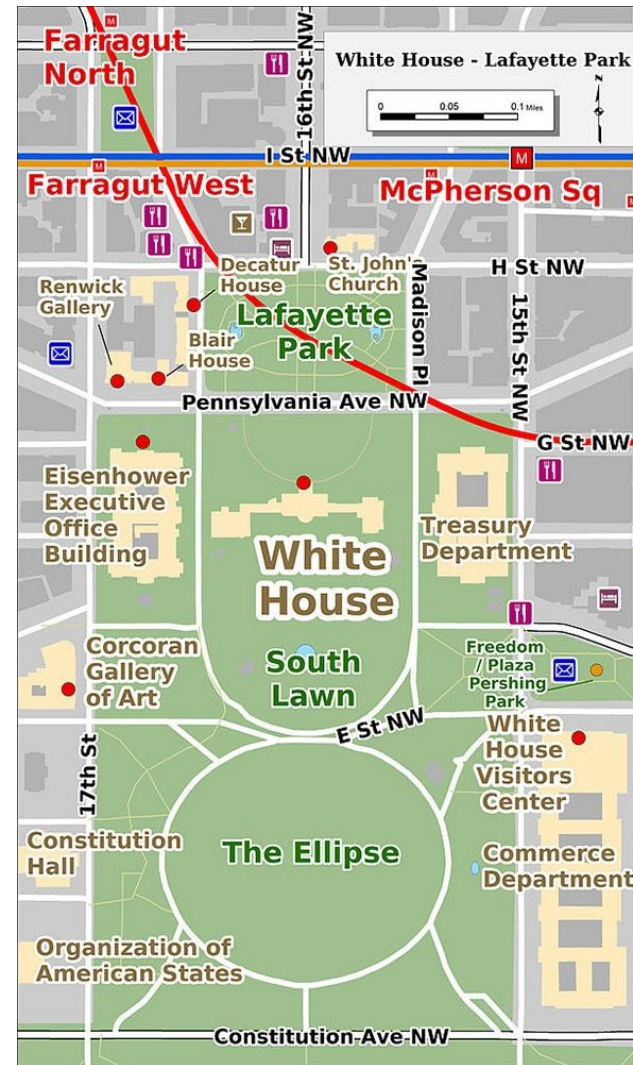


Essential Ingredient #3:

Vector Data

- Vector data uses points, lines and polygons that represent location, path, distance, etc.

Geo-Referenced Data

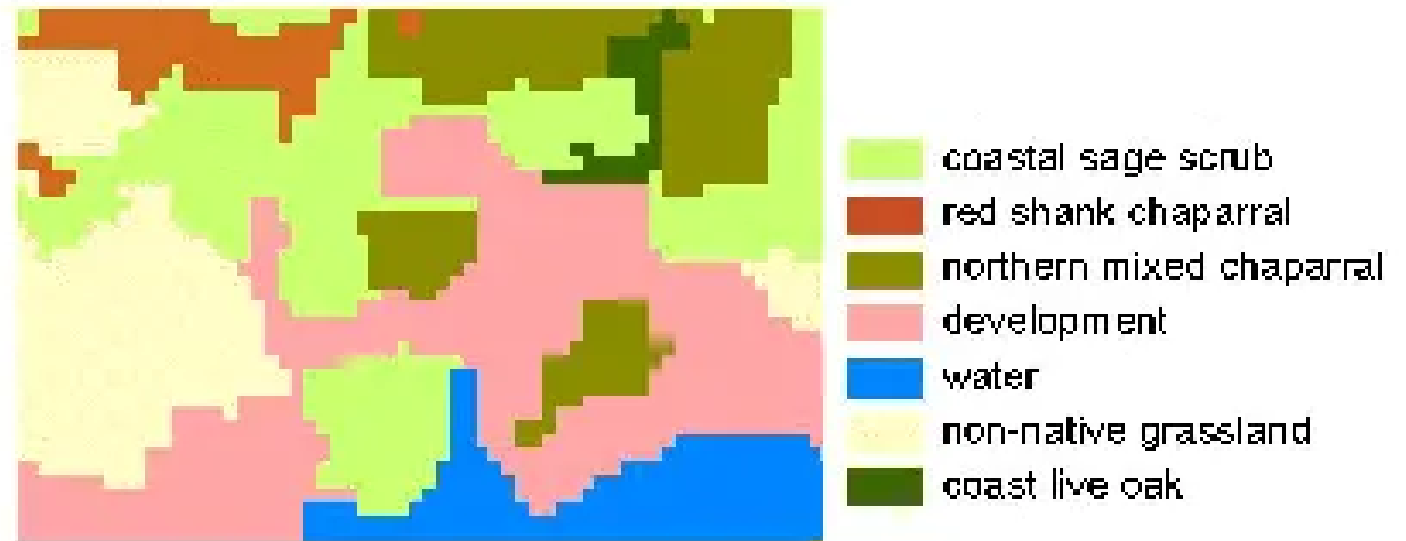


Source: nationalgeographic.org

Essential Ingredient #3: **Geo-Referenced Data**

Raster Data

- Raster formats are grids of cells or pixels. Useful for storing information about features of the world that vary, like elevation.



RASTER DATA SHOWING VEGETATION CLASSIFICATION. THE VEGETATION DATA WAS DERIVED FROM NDVI CLASSIFICATION OF A SATELLITE IMAGE.

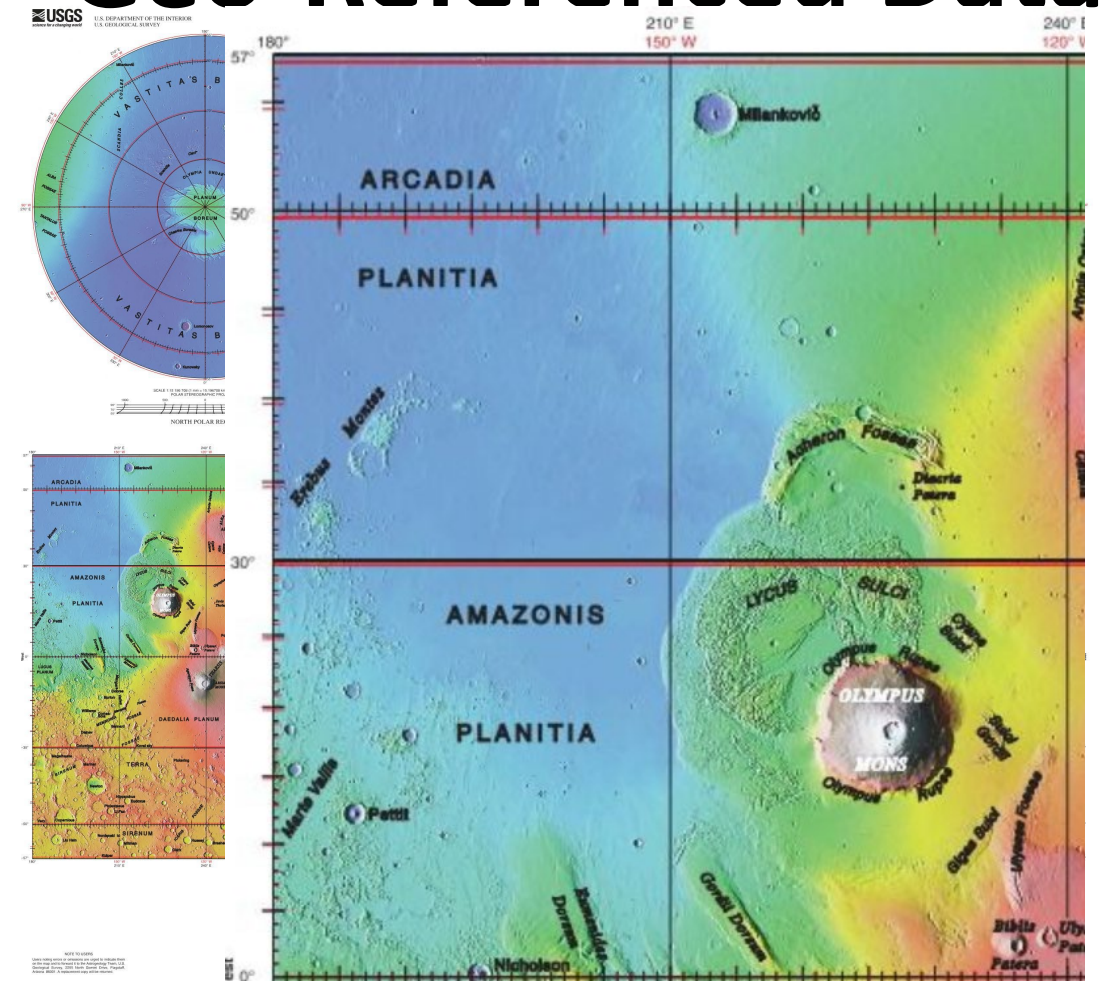
Source: gislounge.com

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Geo-Referenced Data

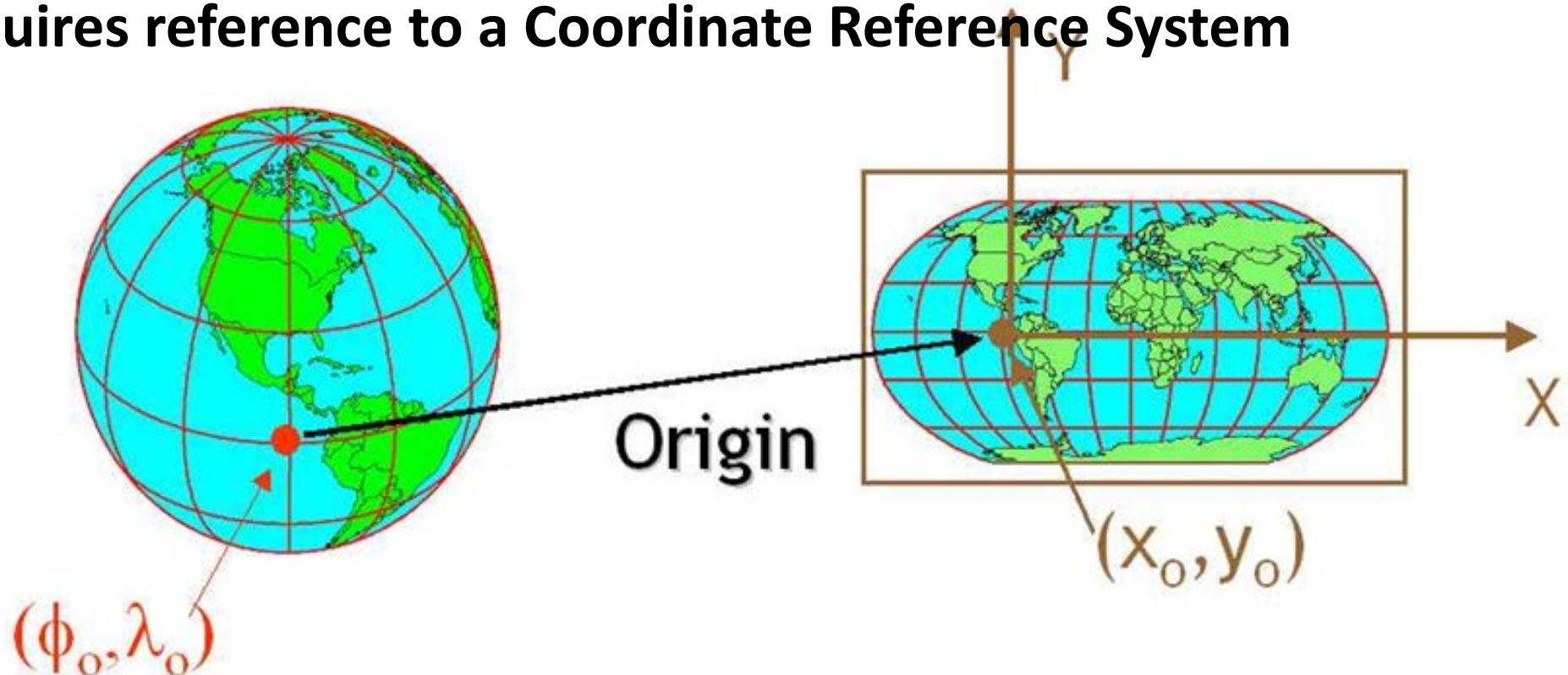


Source: nationalgeographic.org

Essential Ingredient #3: **Geo-Referenced Data**

Spatial data requires reference to a Coordinate Reference System

CRS translates location from the real, 3-dimensional round Earth to the representational, 2-dimensional plane of a paper or screen map.

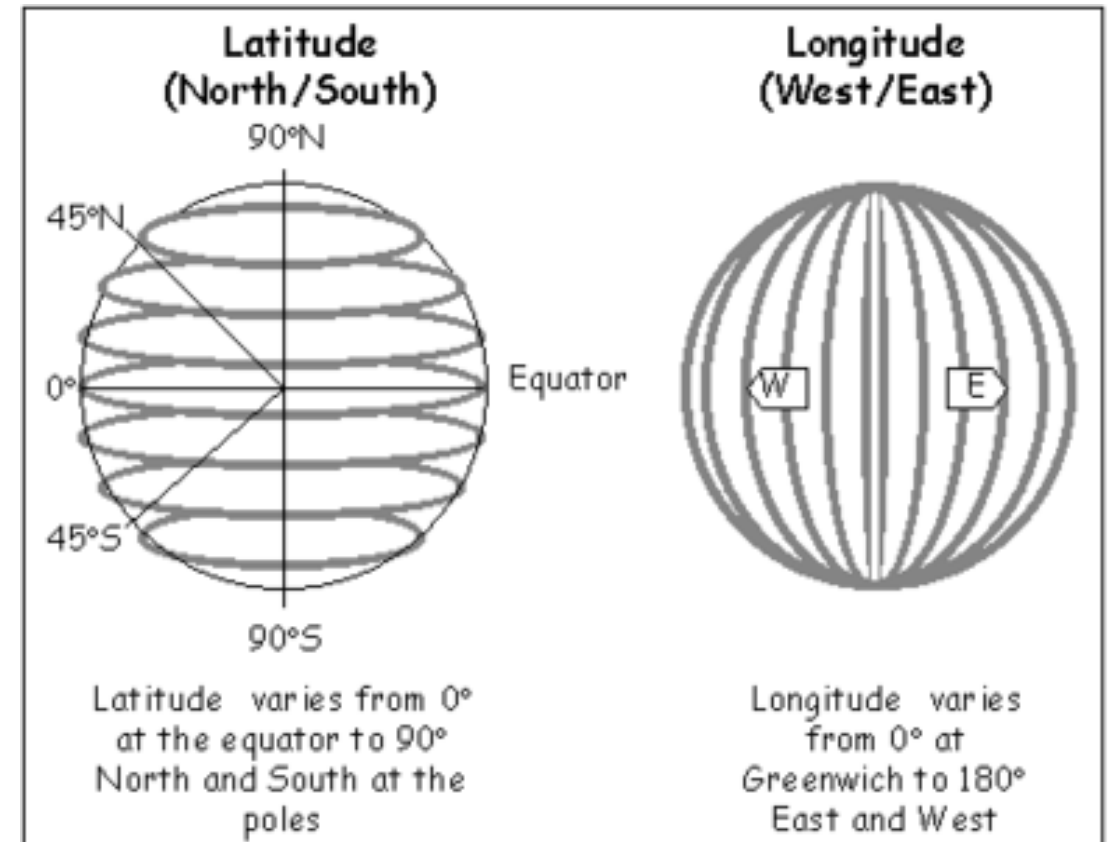


Essential Ingredient #3: **Geo-Referenced Data**

Spatial data requires reference to a Coordinate Reference System (CRS)

Elements of a Coordinate Reference System:

- X and Y grid with Horizontal and Vertical Units (e.g. longitude and latitude)
- Datum - A mathematical average of the shape of the Earth – it's not perfectly round!
- **Map Projection** - a model of the Earth that can be viewed on a flat surface.



Essential Ingredient #3:

Geo-Referenced Data

Map 'Projections'



Essential Ingredient #3:

Geo-Referenced Data

Map 'Projections'

How do you project a 3D object, such as the Earth, onto a 2d dimensional plane, such as paper or a screen?

Imagine peeling an orange, and then flattening the peel on the table.

Some distortions are inevitable with every map projection.

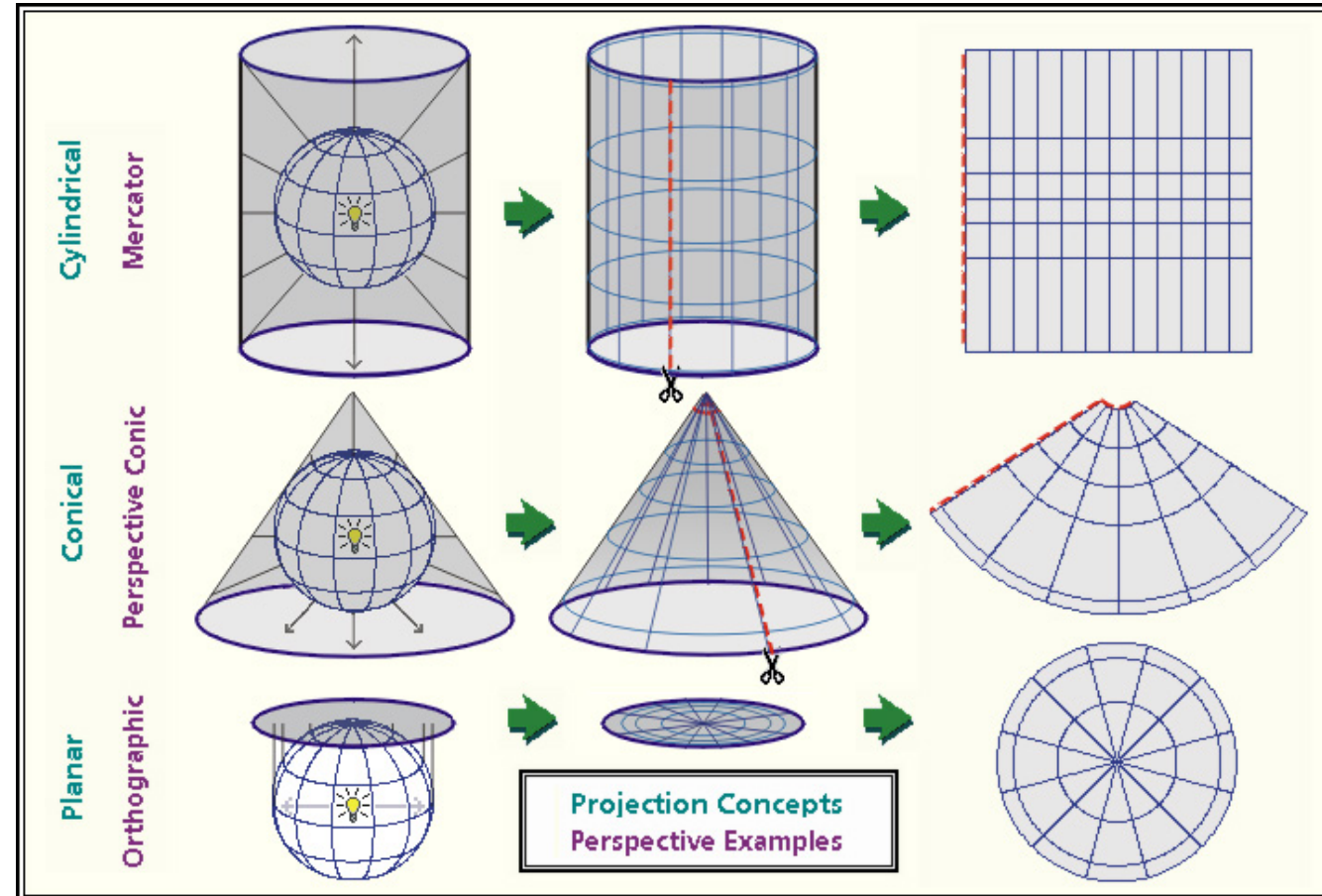


Essential Ingredient #3: **Geo-Referenced Data**

Map 'Projections'

How do you project a 3D object, such as the Earth, onto a 2d dimensional plane, such as paper or a screen?

Imagine putting a transparent globe, with a light bulb in the centre, and projecting the shape of the land masses onto a 2D surface



Essential Ingredient #3: **Geo-Referenced Data**

Mercator Projection

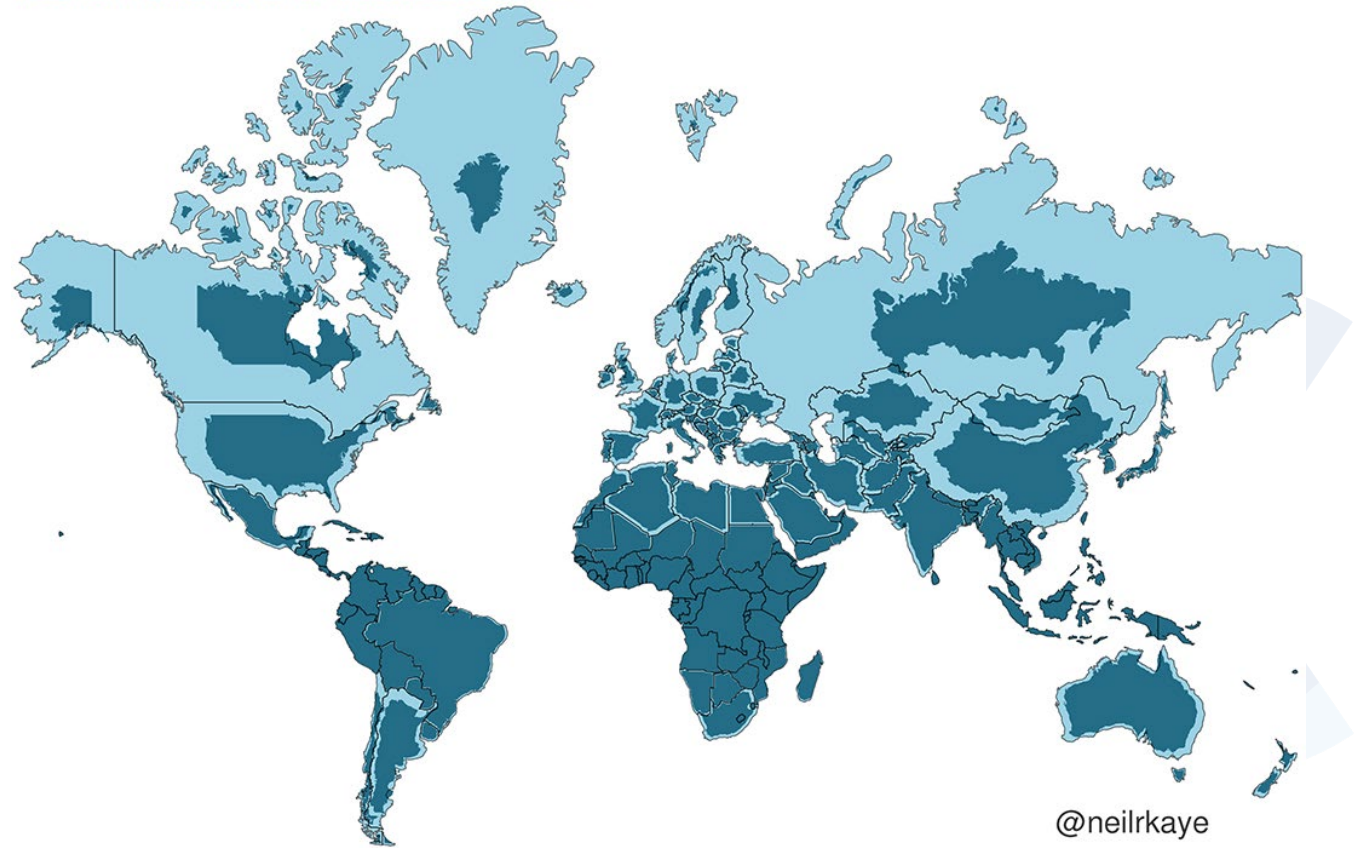


Essential Ingredient #3: **Geo-Referenced Data**

Mercator Projection

Problem of Geographic Inflation

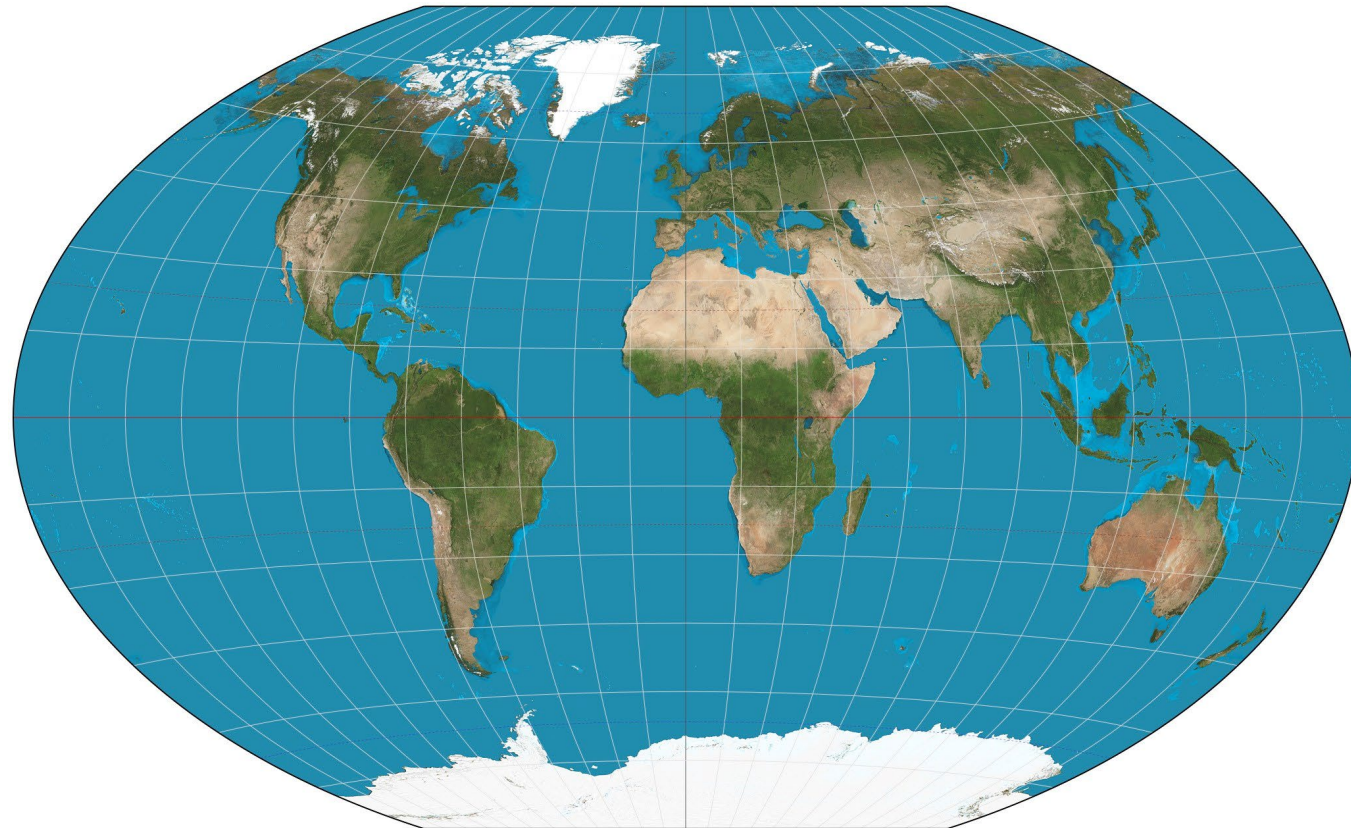
MERCATOR PROJECTION VS THE TRUE SIZE OF COUNTRIES



Source: visualcapitalist.com

Essential Ingredient #3: **Geo-Referenced Data**

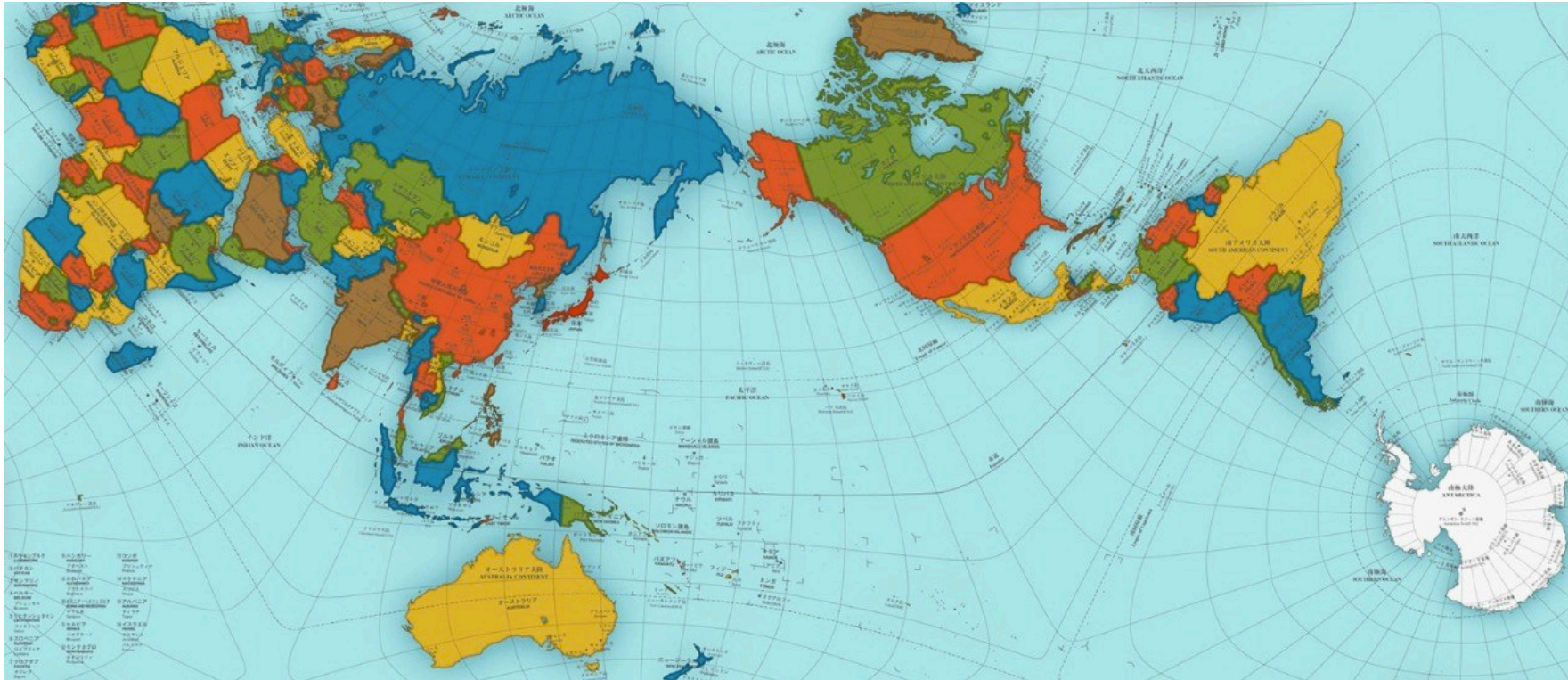
Winkel-Tripel Projection



Source: geoawesomeness.com

Essential Ingredient #3: **Geo-Referenced Data**

AuthaGraph Projection



Source: geoawesomeness.com

Essential Ingredient #3: **Geo-Referenced Data**

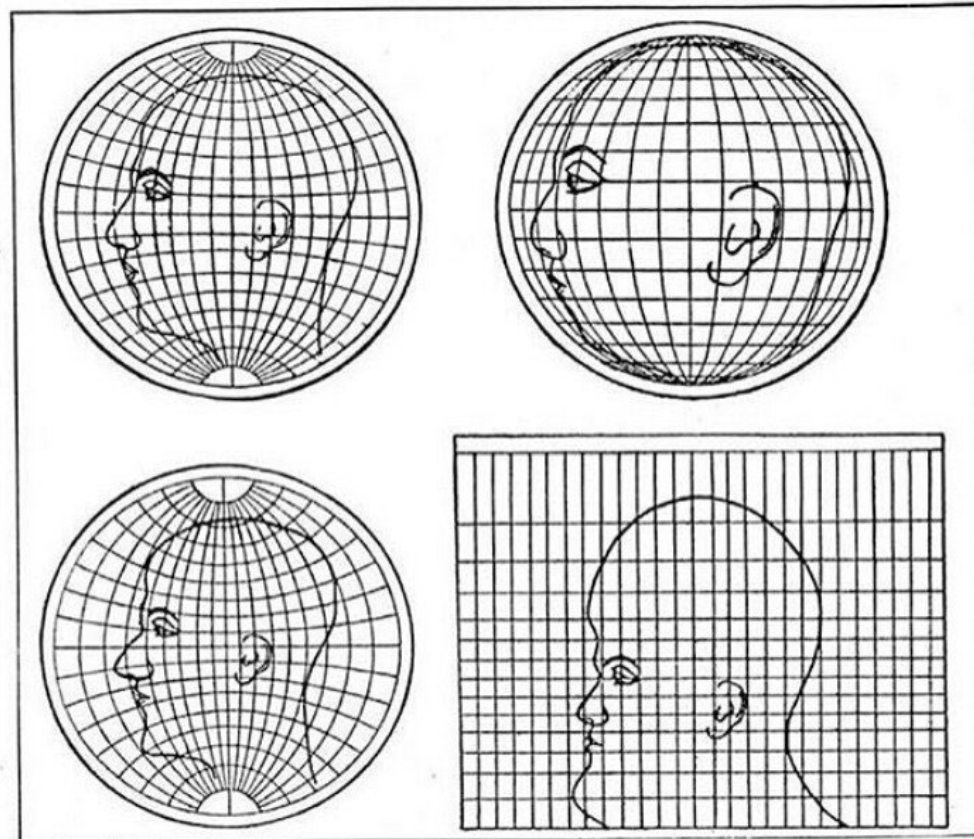
No Map 'Projection' is perfect, all projections create some distortion, particularly on global and continental scales.

GIS data is produced and utilized by many different people and organizations, all using different coordinate referencing systems, datum and map projections.



Source: Earthscience.org

Essential Ingredient #3: **Geo-Referenced Data**



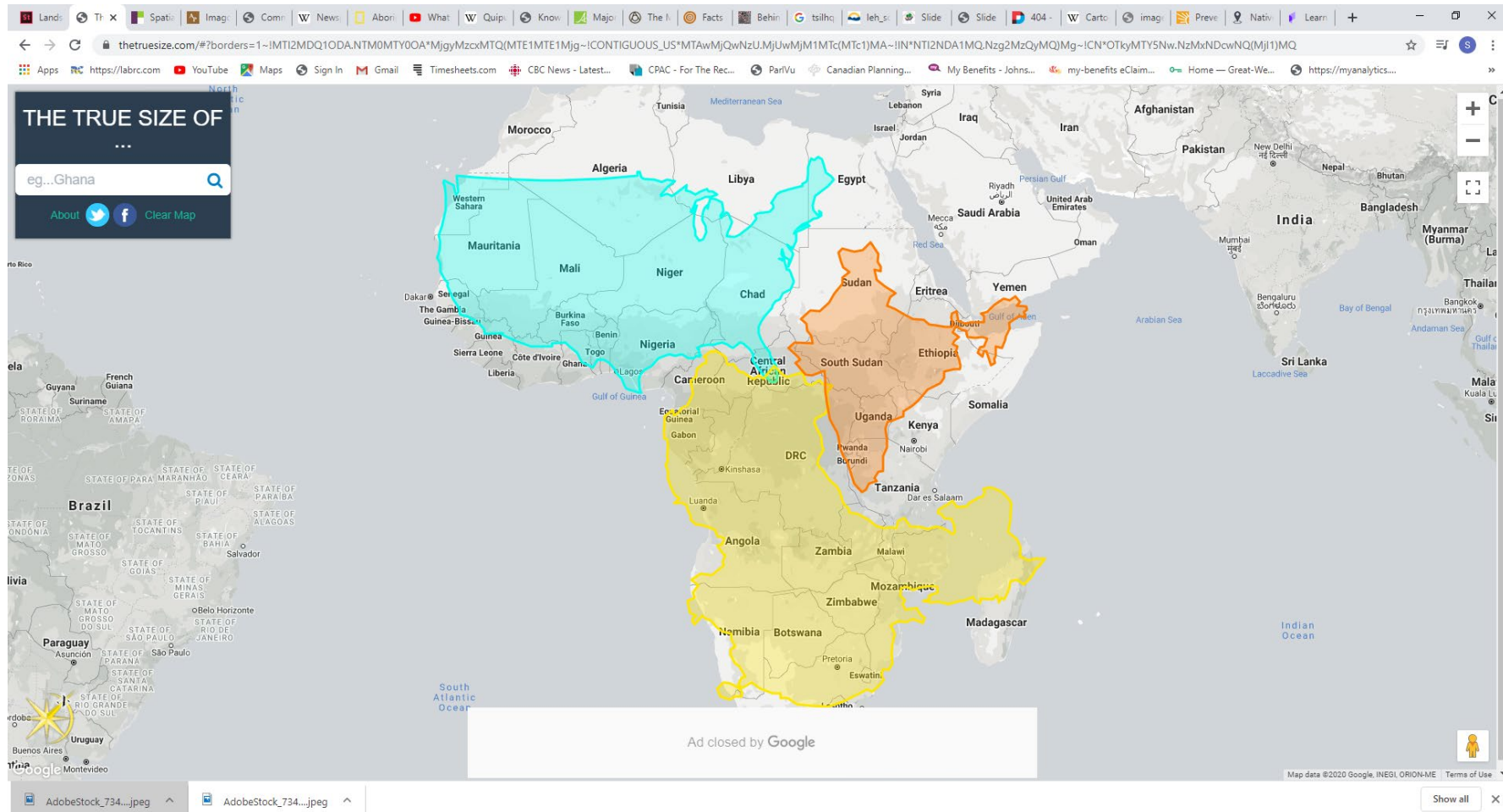
*Upper left: Globular. Upper right: Orthographic. Lower left: Stereographic.
Lower right: Mercator*

What four commonly used projections do, as shown on a human head

Source: Earthscience.org



Essential Ingredient #3: Geo-Referenced Data



Essential Ingredient #3: **Geo-Referenced Data**

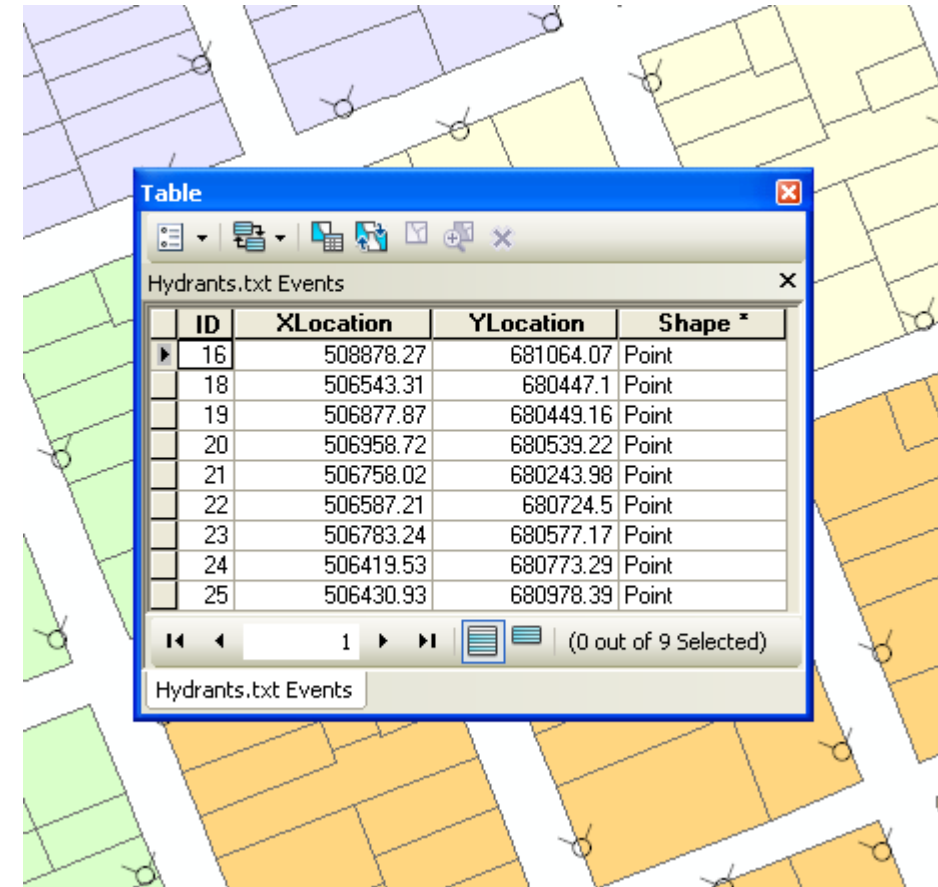
Meta Data



Essential Ingredient #3: Geo-Referenced Data

Meta Data

- “Data about data”. Further detail and description about GIS data that helps a GIS user understand the context in which the data was collected and is being used.
- Stored in Tabular form, called an **Attribute Table** in your GIS software.



The image shows a screenshot of a GIS software interface. A window titled 'Table' is open, displaying an attribute table for a layer named 'Hydrants.txt Events'. The table has four columns: 'ID', 'XLocation', 'YLocation', and 'Shape *'. The data rows show hydrant locations with their respective IDs and coordinates. The 'Shape' column indicates that all features are 'Point' type. The window also includes navigation controls and a status bar showing '(0 out of 9 Selected)'.

ID	XLocation	YLocation	Shape *
16	508878.27	681064.07	Point
18	506543.31	680447.1	Point
19	506877.87	680449.16	Point
20	506958.72	680539.22	Point
21	506758.02	680243.98	Point
22	506587.21	680724.5	Point
23	506783.24	680577.17	Point
24	506419.53	680773.29	Point
25	506430.93	680978.39	Point

Source: arcgis.com

Essential Ingredient #3: Geo-Referenced Data

Meta Data

Identification (purpose of the data, title, description, keywords)

Contact information (author, originator, publisher, distributor, etc.)

Quality (test for completeness, integrity and inspections of data)

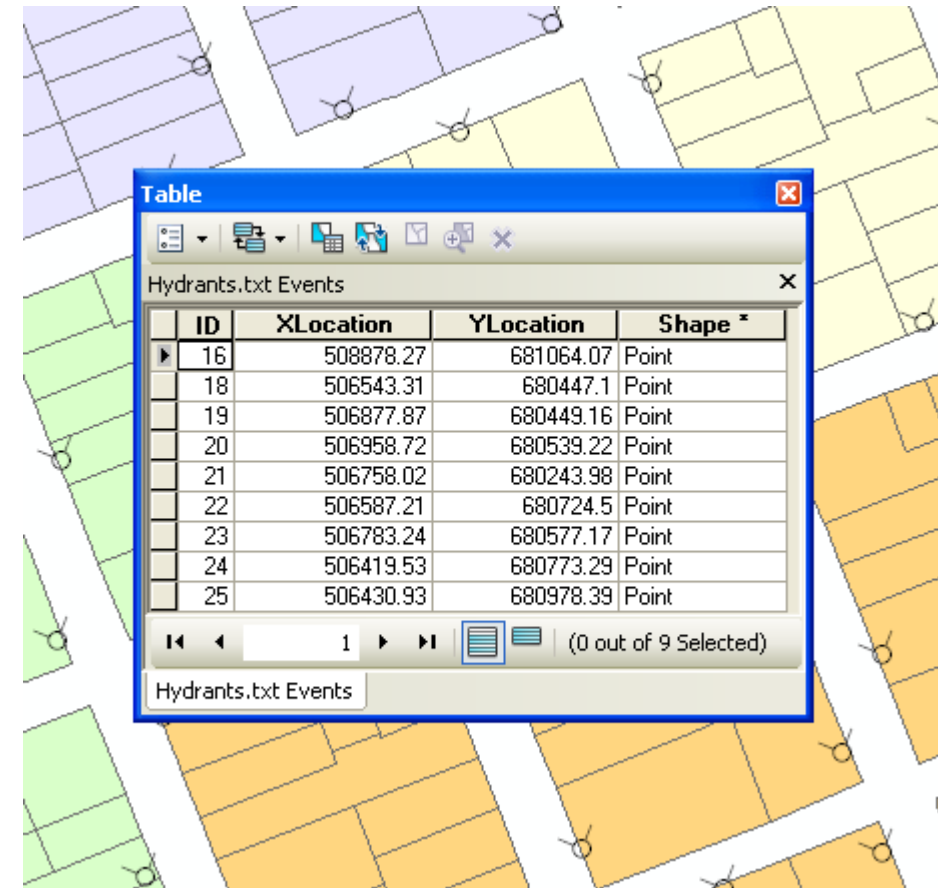
Spatial Reference (what coordinate referencing system is used, where it is in relation to the CRS)

Entity and Attribute (how is the data represented, i.e. vector or raster based, and what values are associated with the data, e.g. elevation)

Legal (constraints for accessing and distributing data)

Temporal (when the data was collected, accessed, updated)

Metadata Standards (what standards were followed in data set creation, management, etc.)



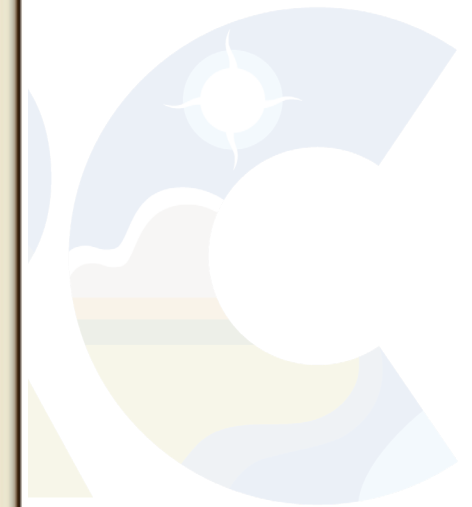
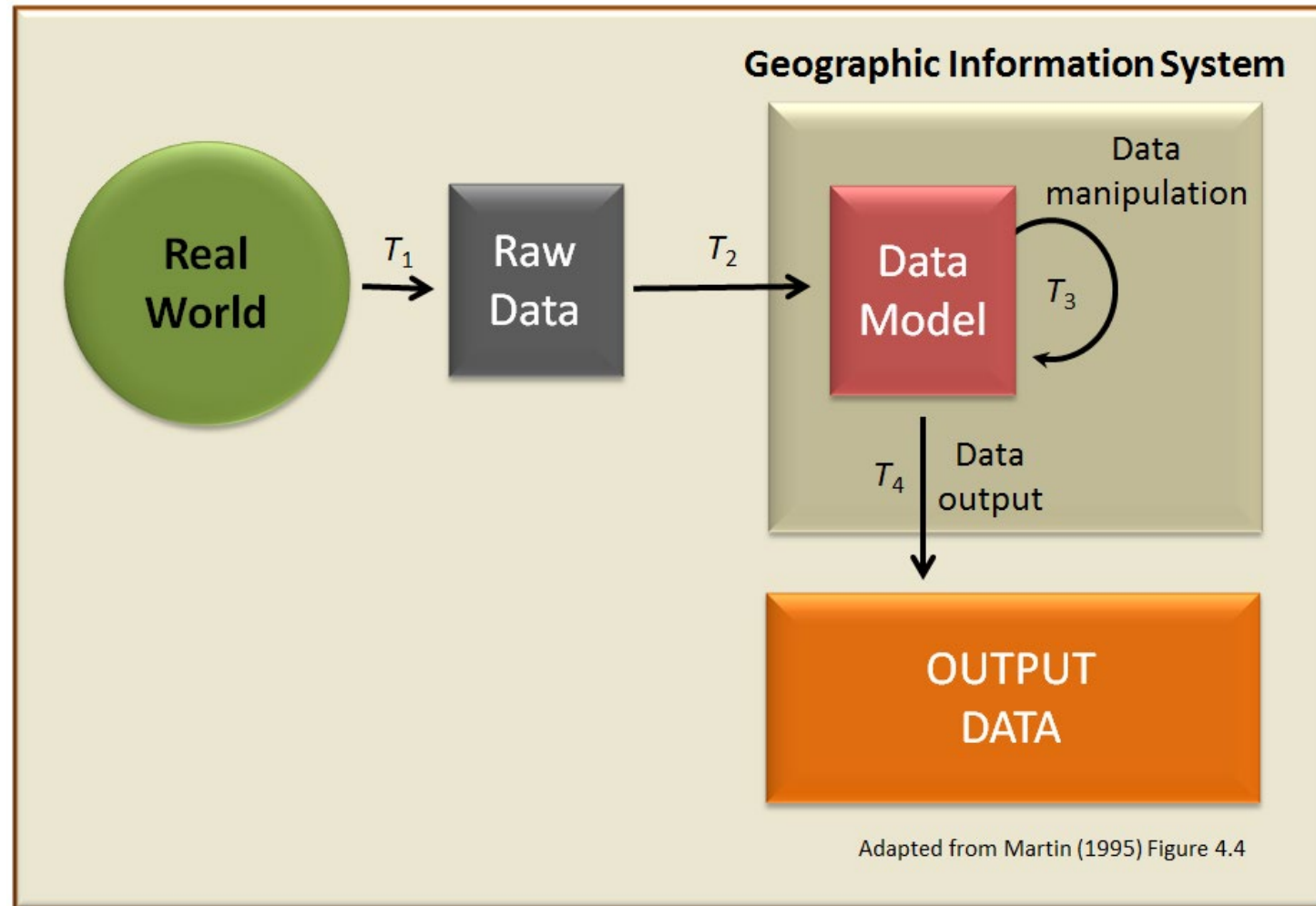
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25	506430.93	680978.39	Point

Source: nationalgeographic.org

Essential Ingredient #4: **DATA GOVERNANCE**



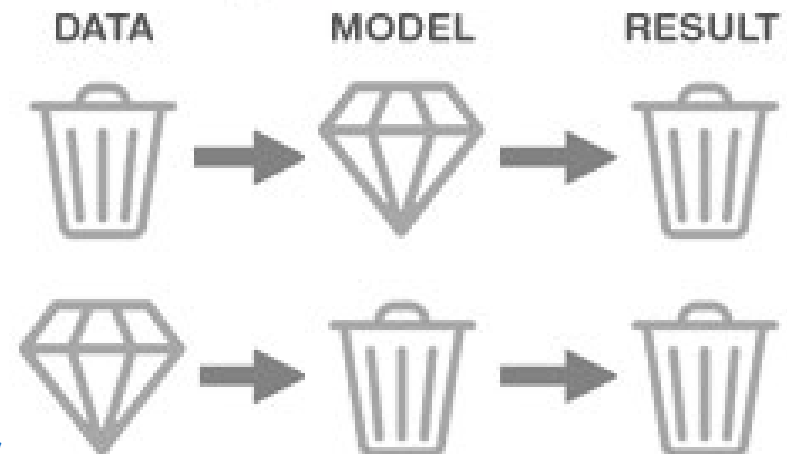
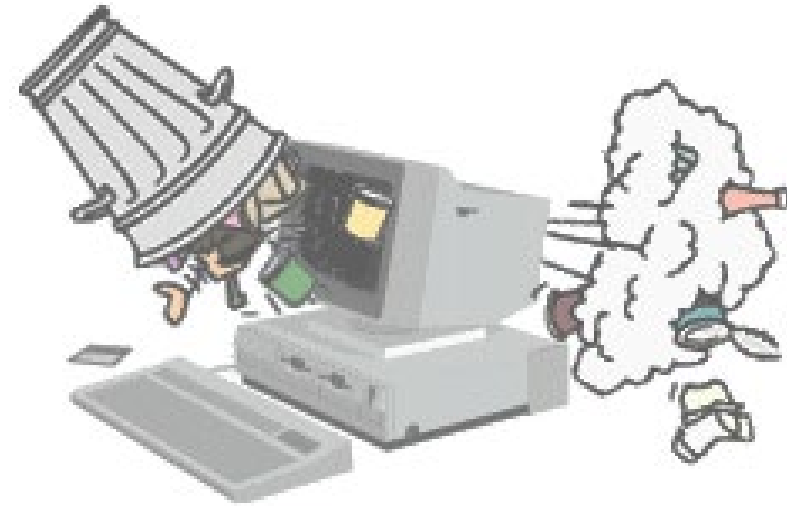
Essential Ingredient #4: **DATA GOVERNANCE**



Essential Ingredient #4:

DATA GOVERNANCE

Garbage in, Garbage Out

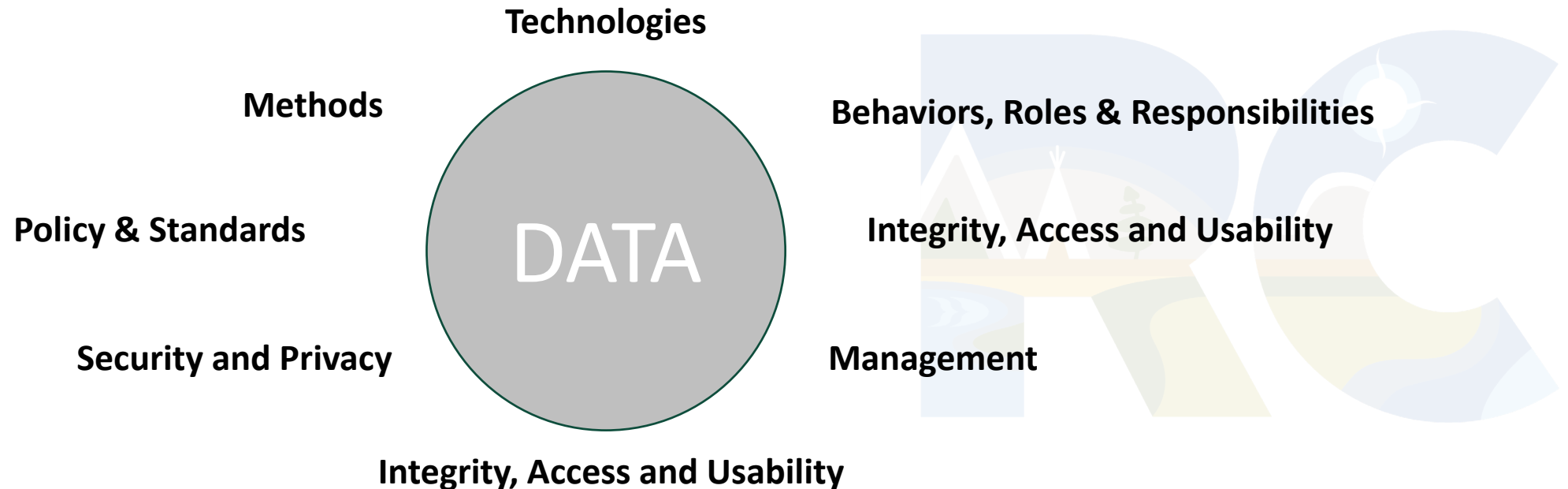


Essential Ingredient #4: **DATA GOVERNANCE**

or Data Stewardship

“A collection of practices and processes which help to ensure the formal management of data assets within an organization.”

-dataversity.net



Essential Ingredient #4: **DATA GOVERNANCE**

How do we ensure Data Stewardship?

Create a Community GIS Standards & User Guide

- Overall Guide for the GIS staff/Department
- Introduce key concepts, definitions, purpose & planning context
- Identify your coordinate reference system, projection system, and datum
- Data Normalization – consistency in how people create, access, use, display and distribute
- Data management guidelines: filing structure, how/where information is saved, nomenclature
- Consistency in how Meta Data is managed/input/controlled/updated



Essential Ingredient #5: **Technical Capacity**

Creating, maintaining and utilizing a GIS requires someone with that technical capacity.

Post-secondary training

Time & \$\$



Essential Ingredient #6: **Planning Need**



Applications of GIS in Lands Governance Planning

Lands Data Inventory

- Boundaries, Parcel Fabric, Lot information
- Land Interests
- Allotments, Wills & Estates

Land Development Planning

- Visioning, Development Concepts
- Land Use & Zoning
- Subdivisions
- Development Permitting
- Compliance Monitoring

Community Planning & Emergency Planning

- Health & wellbeing (age, mobility, etc.)
- Income
- Access & Ingress
- Emergency Operations

Asset Management

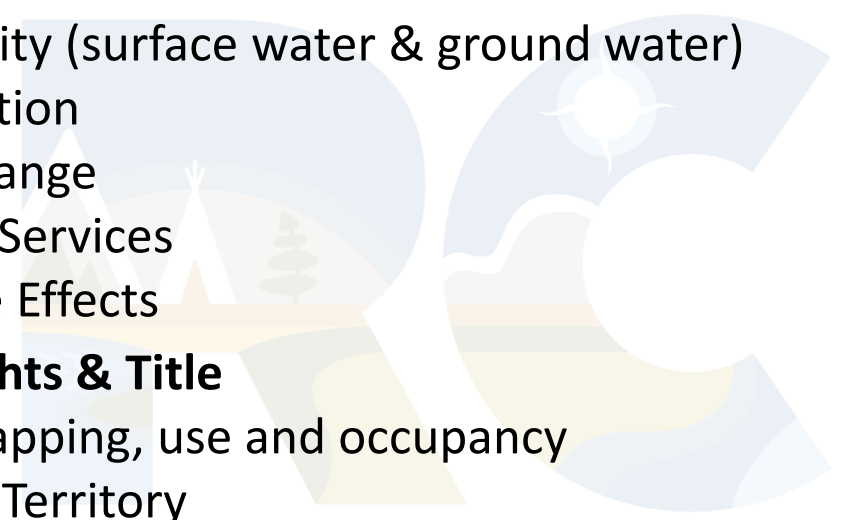
- Infrastructure mapping
- Housing inventory
- Housing & infrastructure related data

Environment & Resource Management

- Environmental Site Assessments
- Habitat, Natural Areas & Parks
- Water quality (surface water & ground water)
- Contamination
- Climate Change
- Ecosystem Services
- Cumulative Effects

Aboriginal Rights & Title

- Cultural mapping, use and occupancy
- Traditional Territory
- Development Referrals
- Negotiations, Impact Assessments



Community example of Planning for GIS

Planning Phases:

Pre-Planning

Planning

Implementation

Monitoring & Evaluation



COMPREHENSIVE LAND USE PLAN 2017
(FINAL DRAFT TO BE ADOPTED)

LONG PLAIN FIRST NATION

Lands Department | Land Use Plan Project | May 16, 2017

Community example of Planning for GIS

Planning Phases:

Pre-Planning

Comprehensive Land Use Plan Phase 1 (2015)

- Staff/Council Working Group & Staff Advisory Group
- Develop a LPFN Planning Process
- Build Planning Capacity
- Community engagement

Guiding Principles:

“Based on our Ojibway First Nation philosophy, religion, history, traditions, culture experiences, the following principles shall be considered in the planning process...

That we adopt modern planning strategies, technologies and concepts such as GIS and GPS mapping and zoning models for the land use plan.”

-LPFN Draft LUP, 2017, p. 10



Community example of Planning for GIS

Planning Phases:

Pre-Planning

Comprehensive Land Use Plan Phase I (2015)

Planning

Comprehensive Land Use Plan Phase II (2015-2016)

-Building Capacity Development in GIS

- create data base
- acquire technology
- collect traditional and historic information

3.2 Comprehensive Land Use Plan Phase II 2015-2016

The Comprehensive Land Use Plan (CLUP) Phase II focused on the developing a draft land use plan, setting goals and guiding principles for the planning process. The goals of the CLUP Phase II Project were to develop a draft land use plan by:

- Appointing and establishing the Working and Advisory groups by the Band Council (CLUP Working Group and Advisory Group).
- Developing terms of reference for the Working Group and Advisory Group;
- Creating a Vision Statement and Mission Statement;
- Coordinating Program Managers, Stakeholders gatherings and workshops to discuss program areas in existing state and discuss future land requirements for housing, economic, social, health, education, recreation, public works and infrastructure, traditional and cultural development;

PAGE 5

-
-
-
- Researching and collecting LPFN traditional and historical information;
 - Developing a First Nation profile; and
 - Building capacity development in GIS mapping technology and data base.

Community example of Planning for GIS

Planning Phases:

Pre-Planning

Comprehensive Land Use Plan Phase I (2015)

Planning

Comprehensive Land Use Plan Phase II (2015-2016)

Comprehensive Land Use Plan Phase III (2016-2017)

- Zoning Maps
- Identify Cultural, Economic Development, Commercial, Agricultural areas, Future Parks, etc.
- Draft Environmental, Emergency Plans
- Map infrastructure, land, water, drainage and aquifers
- Map for emergency plan and emergency services
- Identify and Develop Laws

7.1 Zoning Land Use Areas

The CLUP Planning Team has identified areas of current land use and produced a zoning base map for future planning land use, the team:

- Collected Global Position System (GPS) data of LPFN residential and band owned buildings;
- Collected Geographic Information System (GIS) data from ortho-mosaic land and satellite imagery to classify land areas, natural features such as land, water, forestry, vegetation; new developments such as infrastructure (hydro lines and poles, towers, and agricultural development);
- Collected GIS information in the form of shapefiles to provide a comprehensive overview of LPFN land base, agricultural improvement planning, soil characteristics and classification, regional elevation data, and environmental data;
- Developed reusable models for collected data for drainage plans, determine streamlines, vegetation indexes, and forecast future land uses.

Community example of Planning for GIS

Planning Phases:

Pre-Planning

Comprehensive Land Use Plan Phase I (2015)

Planning

Comprehensive Land Use Plan Phase II (2015-2016)

Comprehensive Land Use Plan Phase III (2016-2017)

Comprehensive Land Use Plan Phase IV (2019-20)

7.1 Zoning Land Use Areas

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Questions to consider if you want to establish a GIS or make good soup:

Do you have the equipment (the kitchen space)?

Do you have the software (the appliances, pots and pans and other necessary tools)?

Do you have the standards & procedures (kitchen etiquette)?

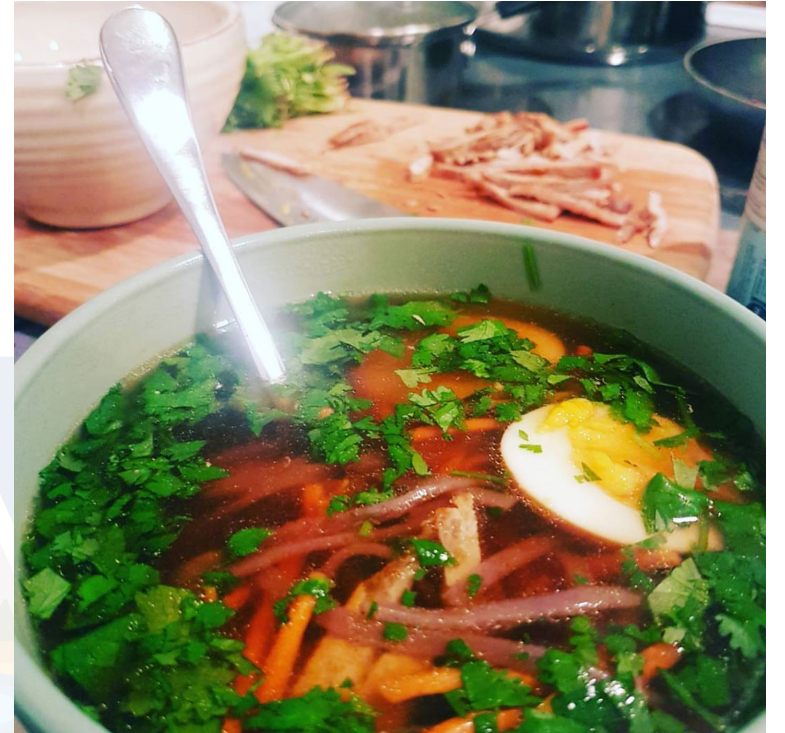
Do you have the technical expertise (chef)?

Do you have access to spatial data (good ingredients and good recipes)?

Do you have the \$ or resources to get what you need?

Do you have the planning need (who are you feeding and why)?

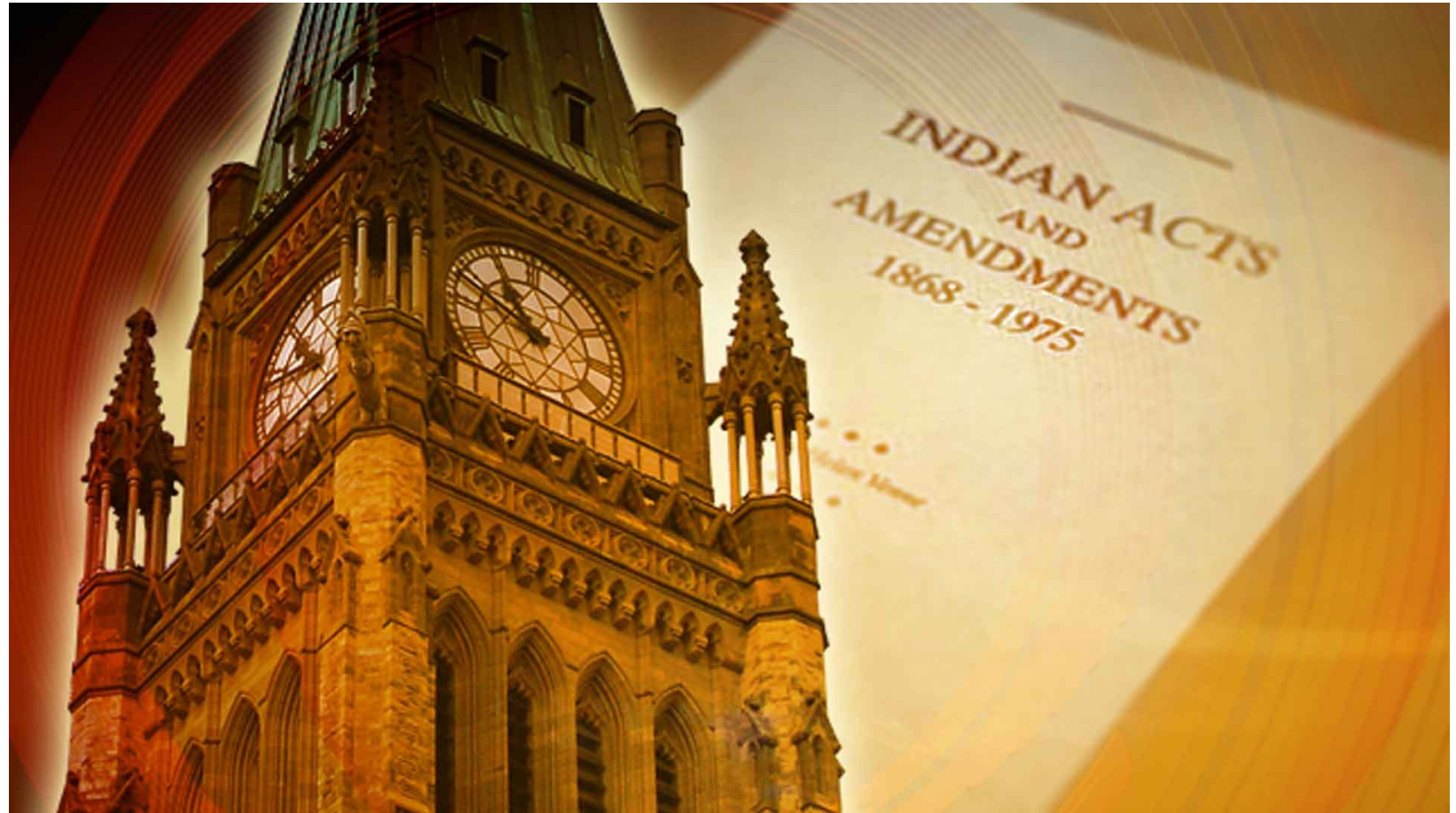
If you want GIS (or good soup), you need to plan for it!



Integrated Planning through GIS:

Repairing the broken planning legacy of the *Indian Act*

The *Indian Act* attempted to wipe away indigenous planning practices and impose colonial methods that were designed to suppress, control and dominate rather than to empower and build resilience.



Traditional Colonial Planning Structures

National/Federal

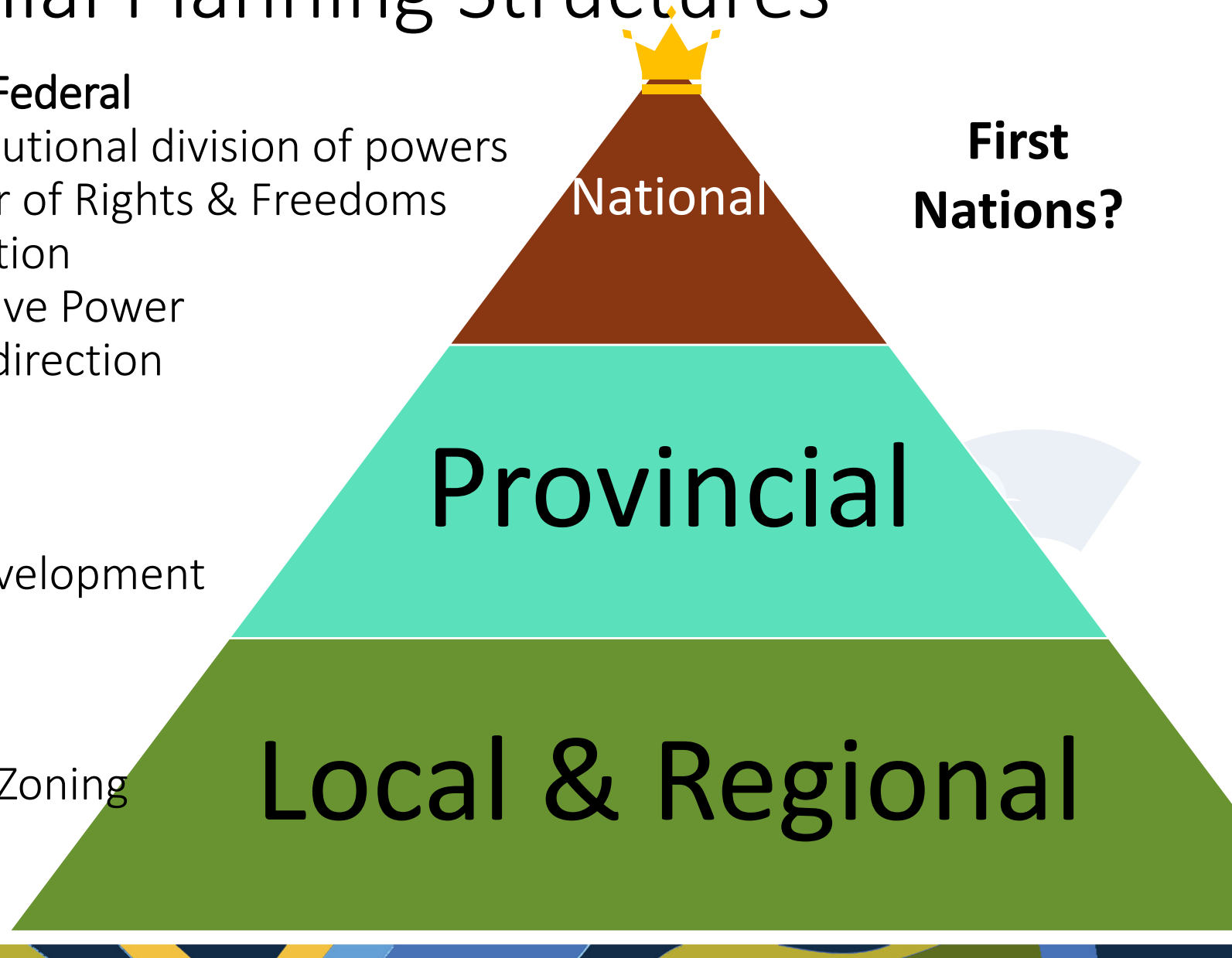
- Constitutional division of powers
- Charter of Rights & Freedoms
- Legislation
- Executive Power
- Policy direction

Provincial/State

- Resource Development
- Property & Civil Rights, Taxation
- Environment
- Municipalities & Community Development
- Planning Legislation

Local/Regional

- Official Community Plan
- Local/Regional Land Use & Zoning
- Development Permitting
- Service Provision
- Bylaw enforcement



Provincial Planning Legislation

Official Community Plan

A statement of objectives and policies to guide decisions on planning and land use management, within the area covered by the plan, respecting the purposes of local government.

Adopted via by-law

Regional context statement

Must include statements and map designations about:

Residential housing requirements for next 5 years

Present and proposed commercial, industrial, agricultural, institutional, recreational and public utility land uses

Restrictions on land use due to environmental sensitivity or hazardous conditions

Approximate location and phasing of any major road, sewer and water systems

Other...

Planning under the *Indian Act*

Physical
Development
Plan

Environmental
Management
Plan



Needs
Assessment

Capital &
Infrastructure
Plan

Strategic Plan

Economic
Development
Plan

Land Use
Plan

Community
Plan

Planning under the Framework Agreement

Physical
Development
Plan

Environmental
Management
Plan

Housing Needs
Assessment

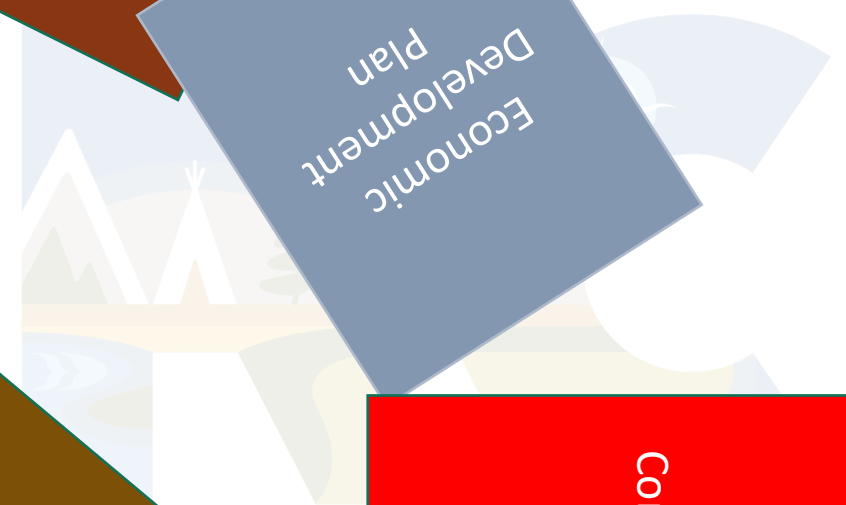
Land Use plan

Capital &
Infrastructure
Plan

Economic
Development
Plan

Community
Plan

Strategic Plan



Framework Agreement on First Nations Land Management

Community Land Code

Land Use Plan

Becomes the Official Plan of your community. Must be followed by Council, staff, economic development, etc.

Typically requires community approval (e.g. ratification). Adopted via Land Use Plan Law

Typically includes land-use designation maps, provides policy direction for future Law and planning development (capital, infrastructure, housing, etc.).

Environmental Management Plan

Set of environmental priorities and operating procedures that can inform Law development

Can be approved by community

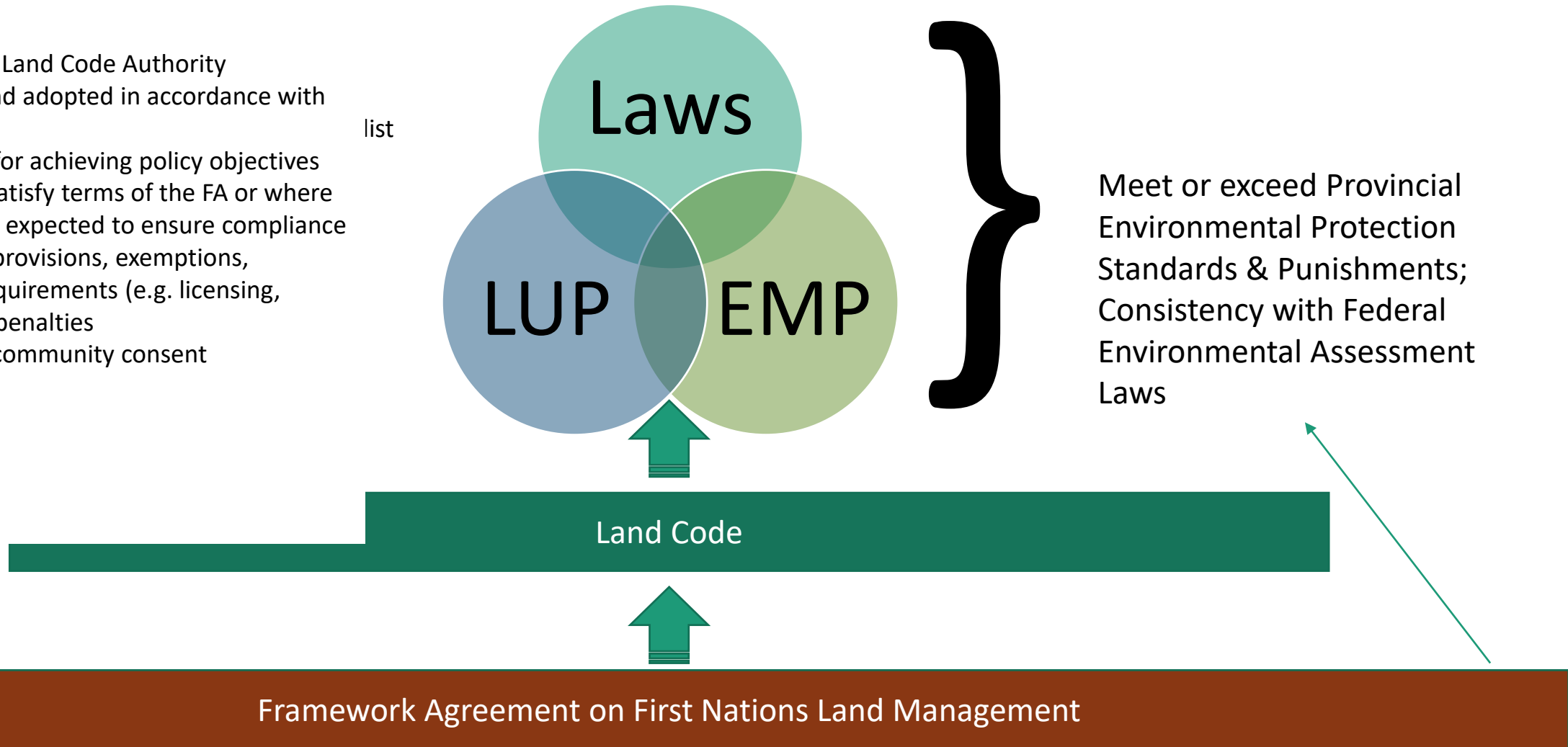
Can be used to inform land development in the absence of Laws.

Lands Governance Planning under the FA

Laws

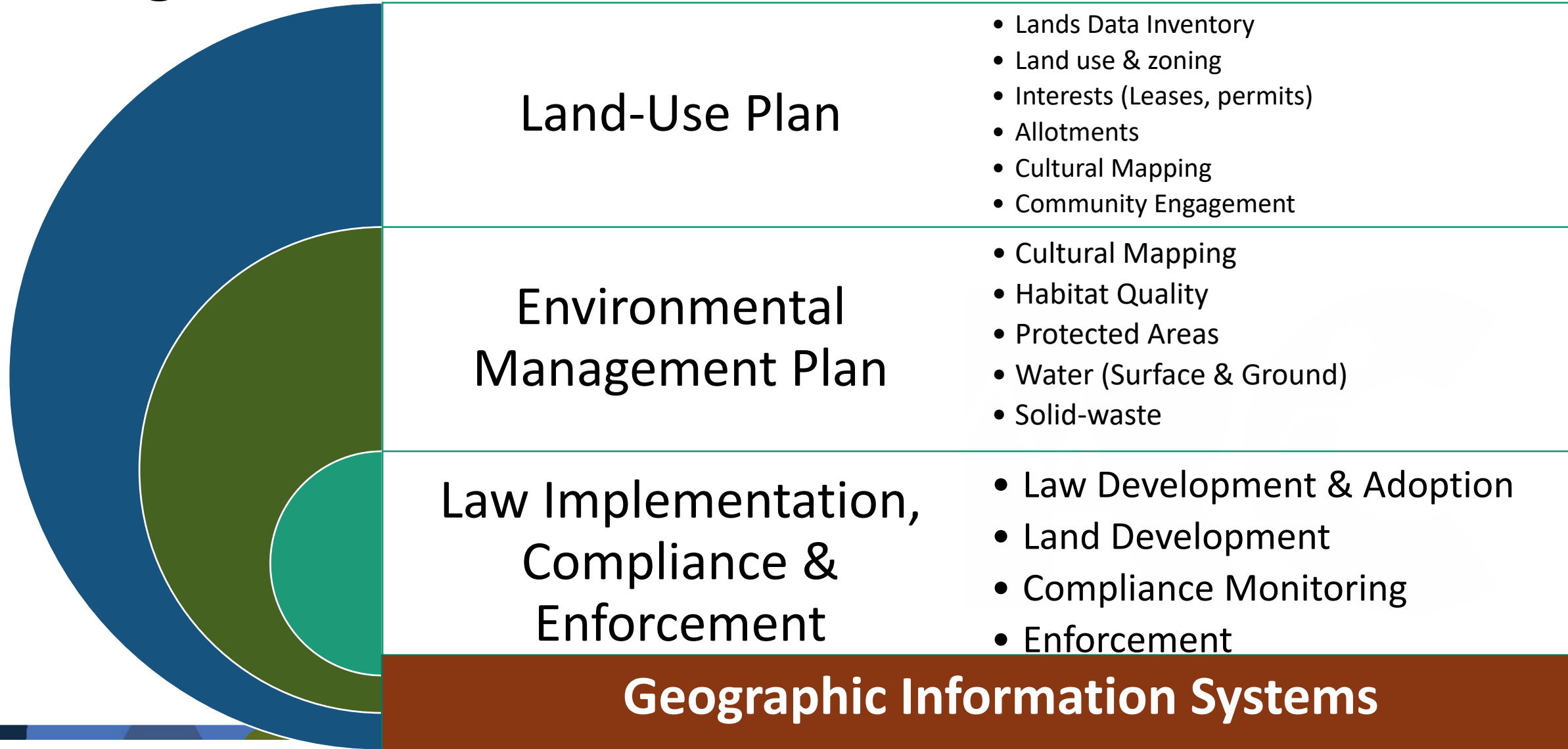
- Derived from Land Code Authority
- Developed and adopted in accordance with Land Code
- Legal means for achieving policy objectives
- Required to satisfy terms of the FA or where legal action is expected to ensure compliance
- May include provisions, exemptions, regulatory requirements (e.g. licensing, monitoring), penalties
- May require community consent

list

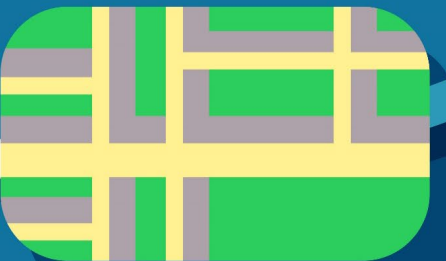


Framework Agreement on First Nations Land Management

Integration of Plans



GIS



Thank you!

Q&A

