VIRTUAL WORKSHOP, Monday, December 6th 11:00 – 5:00 pm (ET)
BREAKOUT SESSION AGENDA

BREAKOUT SESSION 1: INTELLIGENT WATER SYSTEM DEFINITION & SYSTEM UNDERSTANDING

Theme 1- Intelligent Water System (IWS) Definition & Building Blocks (30-minute discussion):

Objectives:

1. Develop a clear definition of Intelligent Water System.
2. Define the enabling aspects of Intelligent Water System.
3. Establish the building blocks of Intelligent Water System.

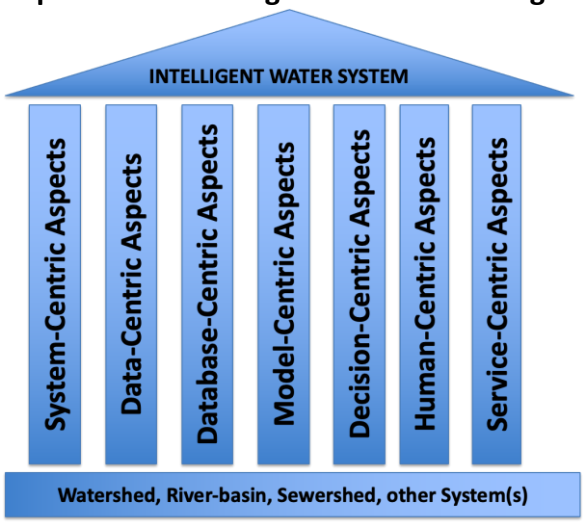
Topics:

- **Many Terms are used synonymously to define water**: Smart Water, Intelligent Water, Internet of Water, Digital Twin, Digital Water, Integrated water, others.
- **Many Definitions have been suggested in the literature. Our Proposed Definition:**

> "An Intelligent Water System is a digital approach to integrate and derive information from cyber-space, physical-space and social-space based on improved system of systems understanding, implementing data collection, database management, modeling techniques, decision support paradigms, and intelligent workforce skills, all to support data driven decision making and optimize lifecycle management of water systems (Natural, Built, & Socio-Economic) that are affordable, reliable, sustainable, resilient, and provide operational efficiencies."

- **IWS will Enable the Water Sector to Adopt Smarter Approaches to Water Management:**

- **Discuss Fundamental Aspects and Building Blocks of an Intelligent Water System:**



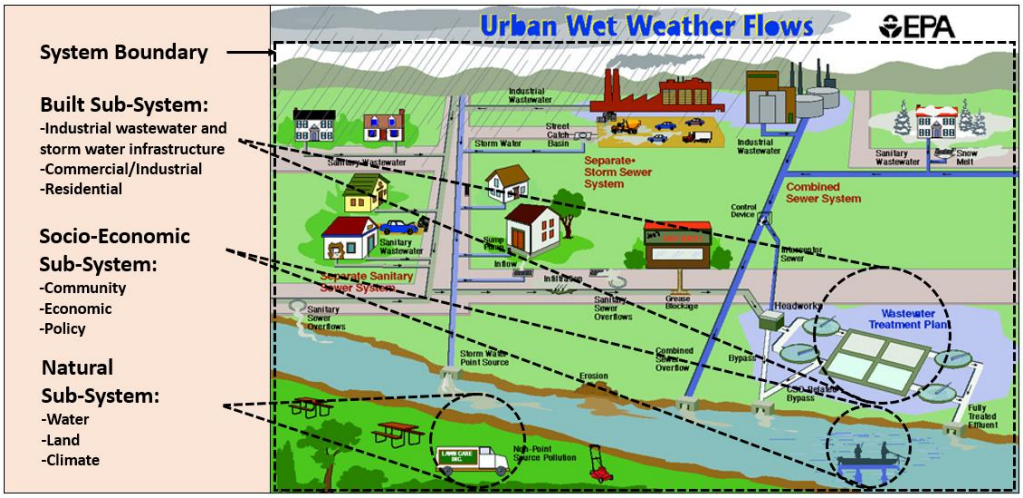
Theme 2- Sewershed-Scale System of Systems Understanding (30-minute discussion):

Objectives:

1. Define the boundary of the studied system of systems.
2. Identify the components within the studied sub-systems.
3. Define characteristics and metrics of the components within sub-systems.

Topics:

- **Clearly Define the Sewershed-Scale System of Systems and its Boundary:**



- **Identify Components within Sub-Systems at the Sewershed-Scale:**

Natural Sub-System	Built Sub-System	Socio-Economic Sub-System
Water: Rivers, Lakes, Oceans, Waterbodies, Groundwater **Land**: Land Cover, Vegetation, Forests, Landfills, Green Infrastructure, Riparian Zones **Climate**: Rainfall, Temperature, Extreme Events	**Wastewater and Stormwater Infrastructure:** Drain Inlets & Outlets, Drainage Ponds, Bioswales, Dams, Storage Tanks, Pipelines, Valves, Pumps, Manholes, Wastewater Plant and Resource Recovery Facility **Households:** Residential waste **Commercial/Industrial:** Regulated and unregulated effluents	**Community**: Residents, Businesses, Population Growth, Ecology & Environment **Economic**: Revenue, CIP, O&M, Liability Costs **Policy**: Organizational Structure, Regulations, Laws and Governance

- **Define Characteristics and Metrics of the Components within Sub-Systems:**

Natural Sub-System ⟷	Built Sub-System ⟷	Socio-Economic Sub-System
Water: Surface Water Quality & Quantity, Groundwater Quality and Table Depth **Land:** Agricultural Runoff, Topography, Geology, Landfill Runoff, Impervious Land Runoff, GI Water Retention **Climate:** Rainfall Intensity and Duration, Forest Fires, Flooding, Droughts, Influent Temperature, Evapotranspiration, Rain & Snow	**Wastewater and Stormwater Infrastructure:** I&I, Flow variations, Capacity, Sedimentation, CSOs/SSOs, Combined/ Separated, Structural Integrity **Households:** Gray and brown water characteristics **Commercial/Industrial:** Regulated & unregulated effluent characteristics	**Community:** Capacity Demands, Customer Needs, Recreational Activities **Economic:** Sources (Bonds, Taxes, Inflation), Budget, Expenditure Forecasting **Policy:** Regulatory concerns, Organizational culture and management, Triple Bottom Line

BREAKOUT SESSION 2: DATA COLLECTION, DATA QA/QC, & DATABASE MANAGEMENT PLAN

Theme 1: Data Collection & Data QA/QC Protocols at Sewershed-Scale (30-minute discussion)

Objective:

1. Identify critical system attributes for a Sewershed.
2. Identify data sources and measurement techniques at sewershed-scale.
3. Identify data QA/QC protocols and best practices.

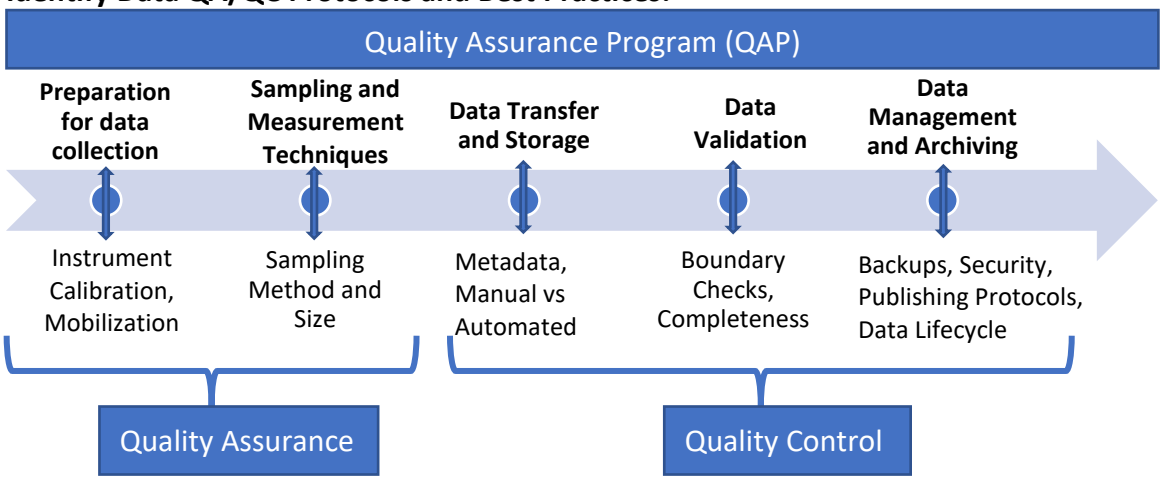
Topics:

- **Identify Attributes for Natural, Built and Socio-Economic Sub-Systems:**

Natural Sub-System	Built Sub-System	Socio-Economic Sub-System
Water: Availability, Demand, Beneficial use water quality **Land**: Land Cover (Vegetation, Impervious Surface, GI) & Topography, Landfill, Agricultural and GI Runoff **Climate**: Rainfall Intensity and Duration (Seasonal, 10 year), Temporal Variations (Seasonal), Wind Speed, Humidity	**Wastewater and Stormwater Infrastructure:** Asset Lifecycle Deterioration, CSOs/SSOs & Wet Weather Flows, Influent Characteristics, Asset Risk and Lifecycle Economics **Households:** Grey and Black Water Characteristics **Commercial/Industrial:** Effluent Characteristics based on Industry Types	**Community**: Median Household Incomes, Population Growth, Customer Engagement **Economic**: Renewal, CIP & O&M Budget (Yearly), Bonds/ Taxes and Revenue Sources **Policy**: MS4, CWA, GASB-34 Specifications, Historical Liability Costs

- **Identify Data Sources and Measurement Techniques at Sewershed-Scale:**

- **Identify Data QA/QC Protocols and Best Practices:**



Theme 2: Database Management Plan at Sewershed-Scale (30-minute discussion)

Objectives:

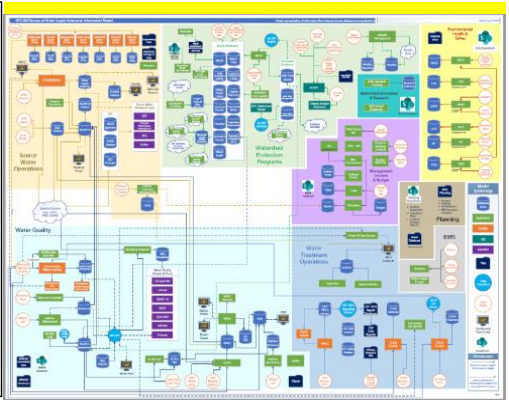
1. Develop database architecture at sewershed scale.
2. Establish database management plan for managing an IWS database.
3. Adopt and integrate existing standards into a framework to enhance Cyber Security.

Topics:

- **Develop Database Architecture at Sewershed Scale**

KEY FEATURES:

- Database Definition
- Database Access
- Relational
- Static & Dynamic
- Multi-user Access
- Data Integrity
- Interpretability
- Features & Types
- Validation Rules



- **Develop Database Management Plan at Sewershed Scale**

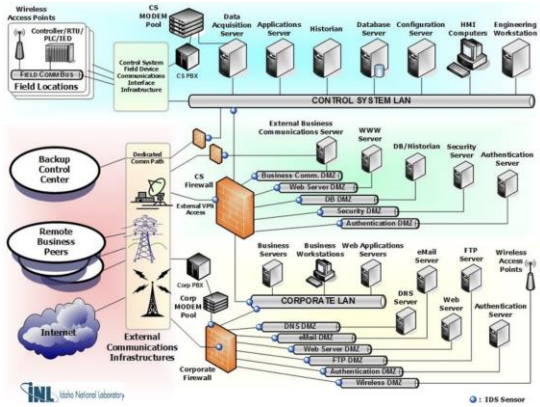
KEY FEATURES:

- Database users
- Data Sharing Protocols
- Data QA/QC Protocols
- External Data Import
- Data Update Protocols
- Archiving and Backups

- **Identify Database Security Risks, Cyber-security Protocols and Best Practices:**

KEY FEATURES:

- Establish Cyber-Security Protocols
- Establishing Cyber-Security team
- Predict, Detect, and Prevent
- Incident Response Plans
- Allocation of Resources
- Regulatory/Reputational and Civil Liability Costs, Cyber Insurance
- User Access Control and Protocols
- Improve, Respond, and Restore
- Business Continuity and Recovery



BREAKOUT SESSION 3: BIG DATA ANALYTICS, AI/ML APPLICATIONS, & DECISION SUPPORT

Theme 1: Data Analytics, and AI/ML Applications at Sewershed-Scale (30-minute discussion)

Objectives:

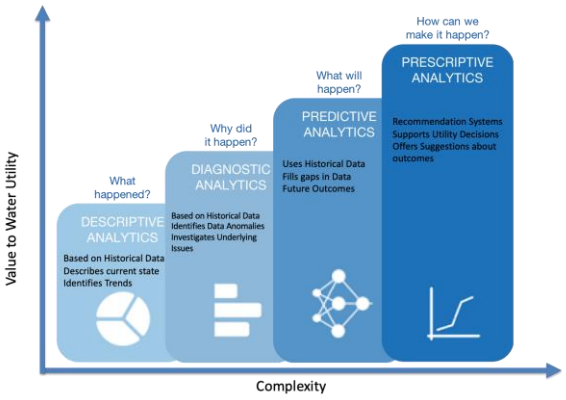
1. Identify modeling techniques for assessment and simulation of natural, built, and social infrastructure systems at sewershed scale.
2. Identify Descriptive, Diagnostic, Predictive and Prescriptive Models and Analytic Tools.
3. Identify Artificial Intelligence techniques used successfully for sewershed modeling.

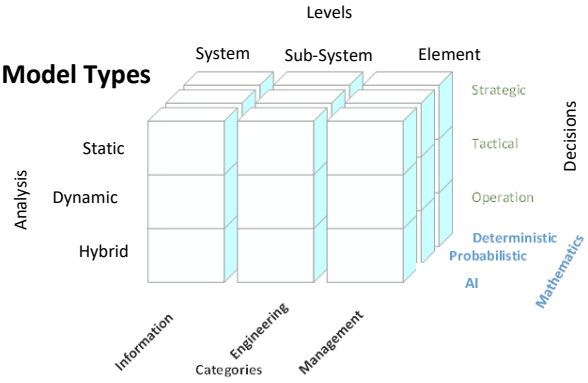
Topics:

- **Identify Existing Modeling Techniques and Methodologies at Sewershed Scale:**

Natural Sub-System	Built Sub-System	Socio-Economic Sub-System
Water: Geogenic Infiltration Potential, Drawdown Levels, Hydrographs **Land:** Landfill Protection Deterioration; Agricultural, GI and Landfill Runoff Contaminant Concentration Prediction **Climate:** Flood Prediction, Rainfall Derived Infiltration and Inflow (RDII) Prediction	**Wastewater and Stormwater Infrastructure:** Asset Deterioration Modeling, Hydraulic Modeling, CSO/SSO Prediction, Risk and Lifecycle Economic Analysis **Households**: Diurnal Pattern Prediction, Demand Forecasting **Industrial/Commercial:** Effluent Flow and Concentration Prediction	**Community:** Public health Impact Correlation **Money:** Budget Optimization, Capital and Operational Expenditure Forecasting **Policy:** Water Allocation Modeling, Water Policy Structure Modeling

- **Classify Models and Tools into Different Mathematical Categories:**

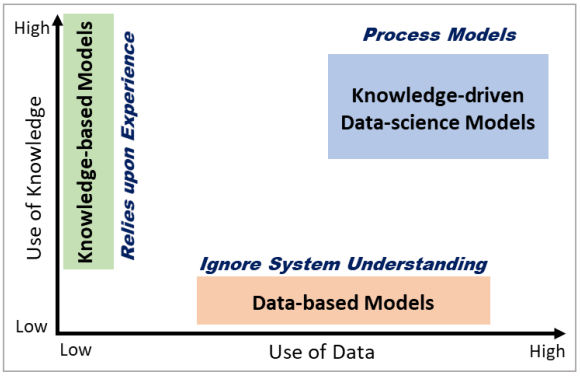




- **Identify AI/ML Data-Centric and Model-Centric Platform for Sewershed Modeling:**

KEY FEATURES:

- Knowledge-guided learning
- Data and Database readiness
- Knowledge & Data Science
- Cyberinfrastructure Platform
- Training & Testing Protocols
- Successful AI/ML Applications
- Model Verification and Validation Protocols
- Generalization of Results



Theme 2: Decision Support, Visualization, and Implementation (30-minute discussion)

Objectives:

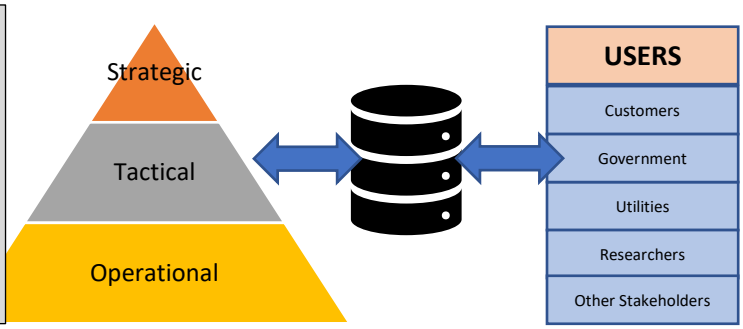
1. Identify domains and users of decision support systems.
2. Establish visualization needs of different stakeholders at sewershed scale.
3. Identify service and implementation system protocols for various stakeholders.

Topics:

- **Identify Decisions in Different Domains and Users of Decision-Support Systems:**

KEY FEATURES:

- Adaptability and flexibility
- High level of Interactivity
- Ease of use, and data access
- Efficiency and effectiveness
- Support for modeling and analysis
- Standalone, and integrated



- **Identify Various Visualization Techniques and Methodologies for Decision-Support:**

KEY FEATURES:

- Goals & Objectives
- Charts, Graphs, etc.
- Dashboards
- Aesthetics and/or visual features
- Structures & Styles

- **Intelligent Water System (IWS) Service and Implementation Methodology:**
  Overview of Logical, Physical, & Digital Architecture for Intelligent Water System