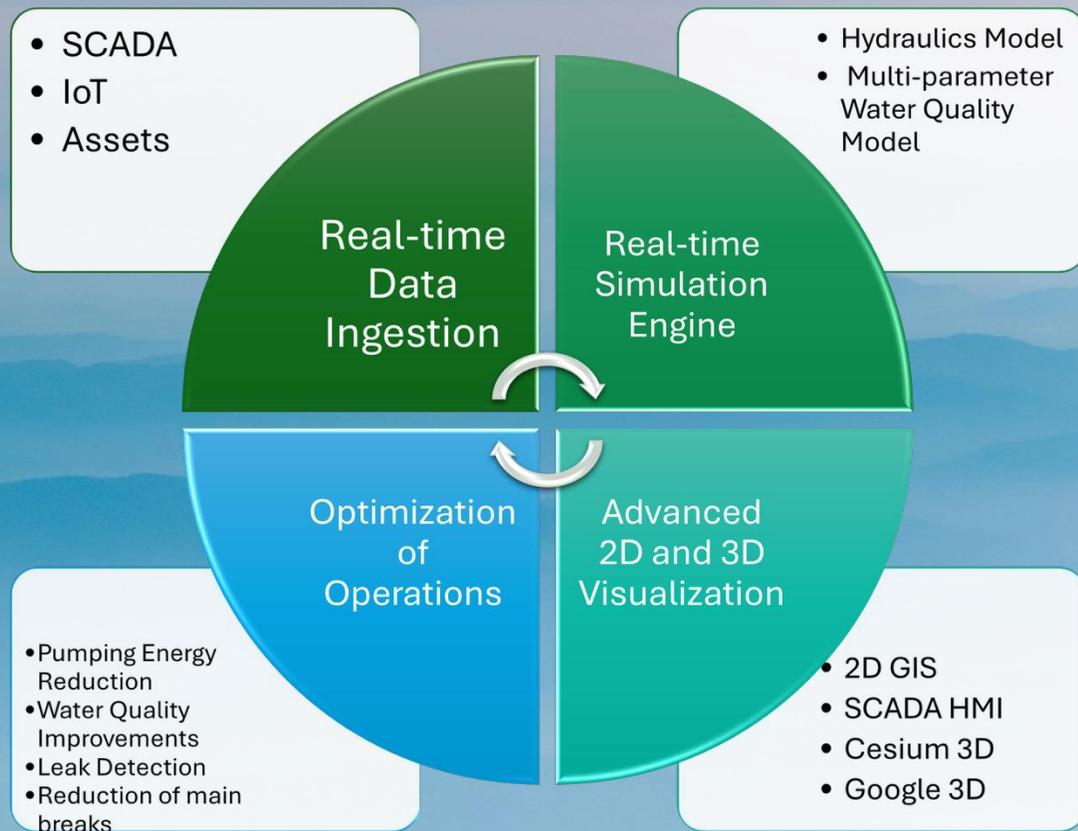# HydroTrek
Global Quality Corp.

AI-integrated Digital Twin (DT) Software Platform for Water Infrastructure

HydroTrek provides Augmented Reality 3D visualization and utilizes AI and physics-based modeling to support decision-making

Drinking Water Distribution System Digital Twin (DWDS-DT) : Overview

- SCADA
- IoT
- Assets

Real-time Data Ingestion

- Hydraulics Model
- Multi-parameter Water Quality Model

Real-time Simulation Engine

Optimization of Operations

- Pumping Energy Reduction
- Water Quality Improvements
- Leak Detection
- Reduction of main breaks

Advanced 2D and 3D Visualization

- 2D GIS
- SCADA HMI
- Cesium 3D
- Google 3D

- Proven technology tested across multiple utilities to reduce pumping costs, improve water quality, and minimize main breaks.

- Real-time model calibration using data from SCADA and IoT systems for accurate system pressure predictions.

- Tools to detect leaks, identify contaminated areas, and prevent system-wide boil-water advisories.

- Continuous simulation of hydraulic and water quality parameters under normal and emergency conditions.

# Drinking Water Distribution System Digital Twin (DWDS-DT) : Features

- Changes the demand values to reflect the actual flows from the pumps and tanks, which then calculates the systemwide pressures with the improved representation.

- Leverages SCADA data and IoT telemetry to change settings in the models. For example, the DT changes a PRV downstream pressure setting or a valve setting to match the SCADA values.

- Shows the impacts of leaks and breaks to improve the determination of resiliency

- Calculates the concentration of multiple water quality parameters at each time step.

# Drinking Water Distribution System Digital Twin (DWDS-DT) : Advantages

- Provides insights into the complex interrelationships between the pressures, the flows, the water quality and the incidents such as leaks and breaks.

- The 3D visualization improves the spatial understanding and highlights the any asset geographic data discrepancies compared to the ground truth.

- Lowers operations energy costs and shows opportunities for improving water quality

- Increases the resilience through the modeling of the impact of what-if catastrophic events

# Water Distribution System Asset Risk Assessment (DSRA) : Overview
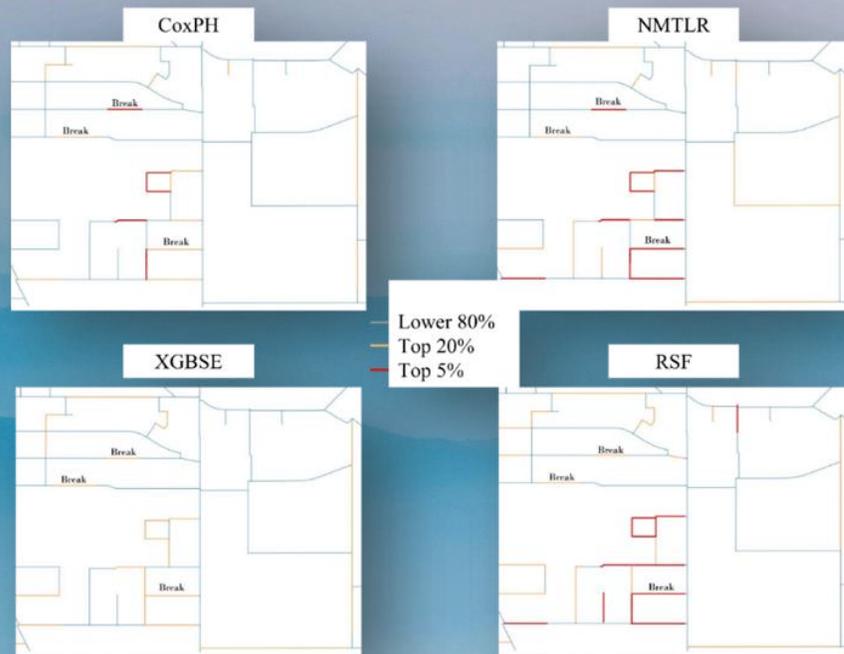
- Machine Learning (ML)-based prediction of Likelihood of Failure (LoF) probabilities for water distribution mains.

- GIS-integrated analysis to calculate Consequences of Failure (CoF) and visualize asset risks spatially.

- Quantifiable business risk reduction by preventing catastrophic failures, reducing non-revenue water (NRW), and improving system reliability.

- A unique "Survival Analysis" approach leveraging multiple ML models for superior predictive performance.

- Proven performance across multiple North American utilities, developed and tested using the UBC Supercomputing Cluster.

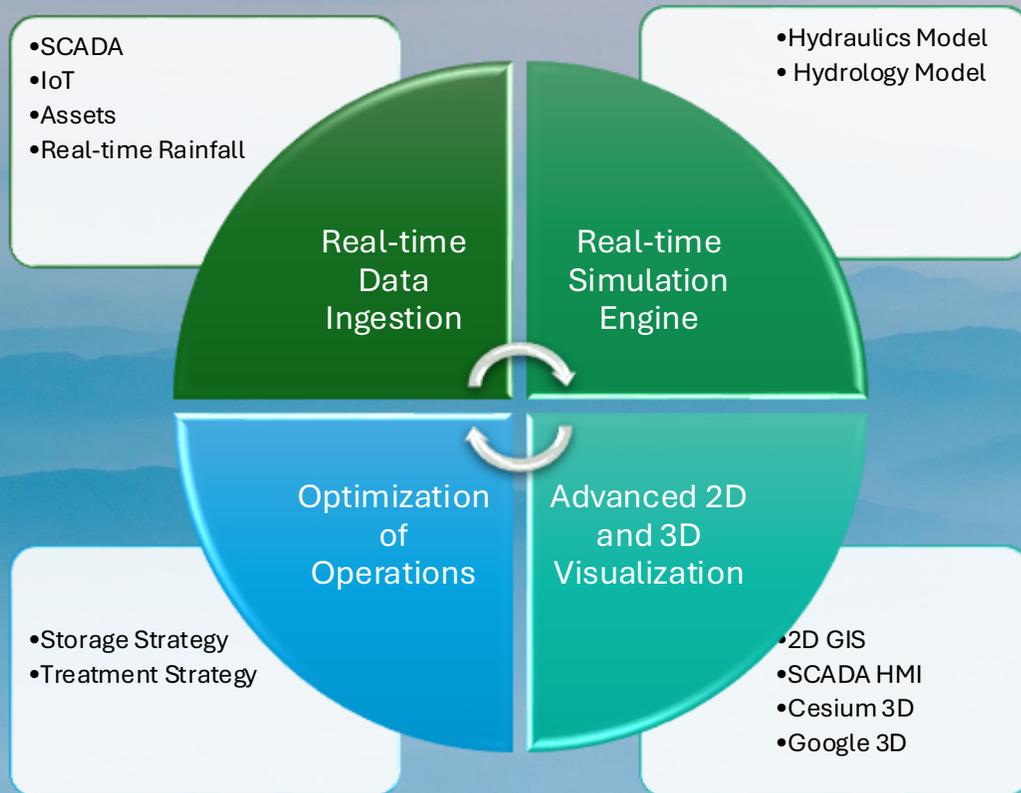# Water Distribution System Asset Risk Assessment (DSRA) : Features
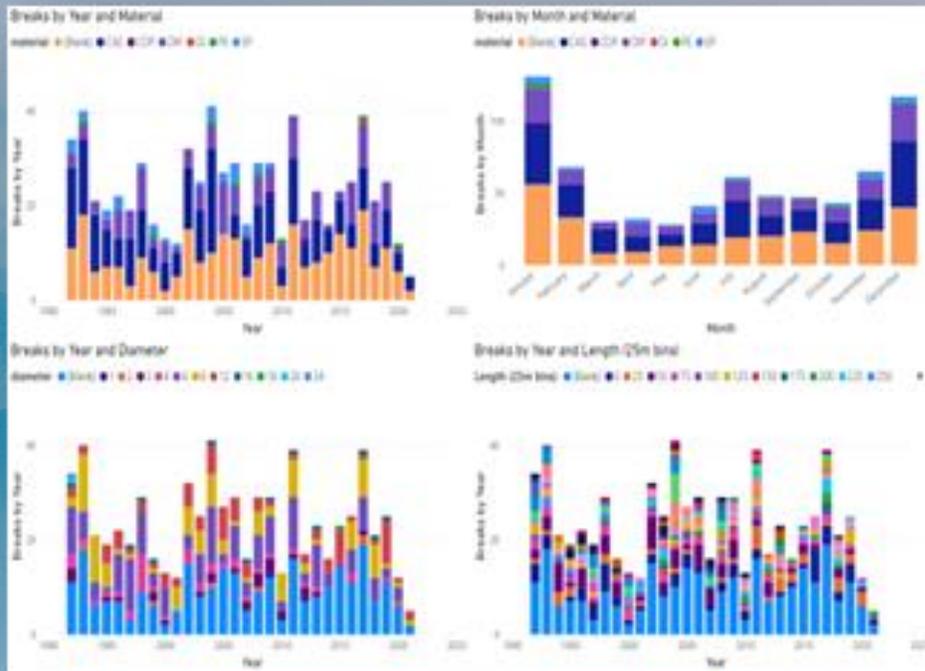
- Functionality to apply off-the-shelf HydroTrek LoF-ML models without developing a custom model

- Ability to leverage available data to create the best ML model. It is not necessary to have large datasets with an extensive set of pipe features.

- Tolerance for noisy data.

- Faster training times for custom ML models using GPUs.

- Advanced GIS-based CoF functionality to determine spatiotemporal impacts of the discharged water on the built-up environment and on the receiving streams.

Water Distribution System Asset Risk Assessment (DSRA) : Advantages

Model Comparison by Utility
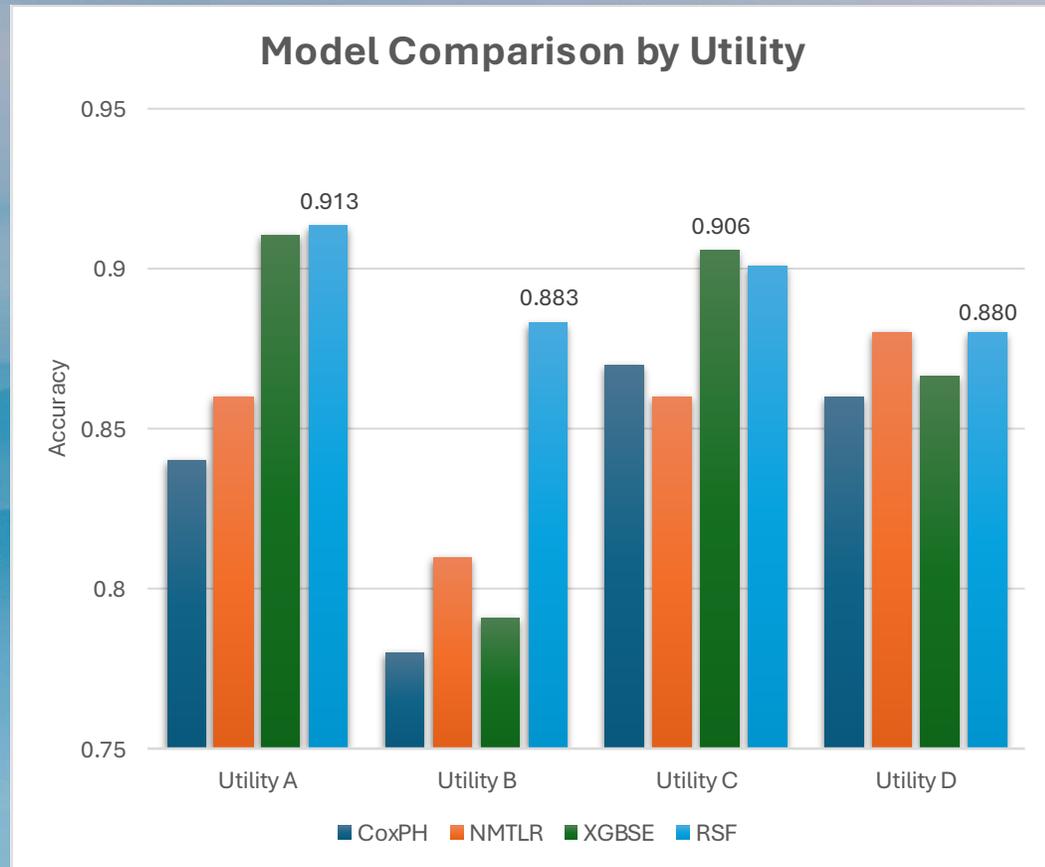
- The ML LoF predictions are several times better than the age-based LoF predictions.

- The "Survival Analysis" approach leads to the construction of a temporal degradation curve for each pipe. Most ML approaches provide a single failure probability of a given pipe.

- Data analytics and visualization improves data understanding and highlights any anomalies.

- A specific ML model can be chosen that works best with the features of the available data.

- The software provides fast calculation of the flow-paths for the discharged water

- The CoF can be carried out in industry standard GIS systems.

Wastewater Collection System (WCS) Digital Twin (DT) : Overview

- SCADA
- IoT
- Assets
- Real-time Rainfall

- Hydraulics Model
- Hydrology Model

Real-time Data Ingestion

Real-time Simulation Engine

Optimization of Operations

Advanced 2D and 3D Visualization

- Storage Strategy
- Treatment Strategy

- 2D GIS
- SCADA HMI
- Cesium 3D
- Google 3D

- A leading SaaS solution developed from multiple projects across sanitation districts.

- Proven deployment across utilities to analyze sources of Inflow and Infiltration (I&I).

- Tools to evaluate strategies for reducing Sanitary Sewer Overflows (SSOs) and Combined Sewer Overflows (CSOs).

- Real-time integration of rainfall, SCADA, and IoT data for dynamic model calibration.

- Comparative visualization of observed vs. modeled flows to improve system calibration accuracy.

- Continuous, real-time simulation of system-wide performance across the entire water network.

# Wastewater Collection System (WCS) Digital Twin (DT) : Features

- Ingests the real-time rainfall and then calculates the systemwide conditions with the improved representation.

- Leverages SCADA data and IoT telemetry to change settings in the models. For example, the DT can change a valve setting to match the SCADA values.

- Shows the impacts of I&I to improve the determination of resiliency

- Calculates the water quality parameters at each time step.

Wastewater Collection System (WCS) Digital Twin (DT) : Advantages
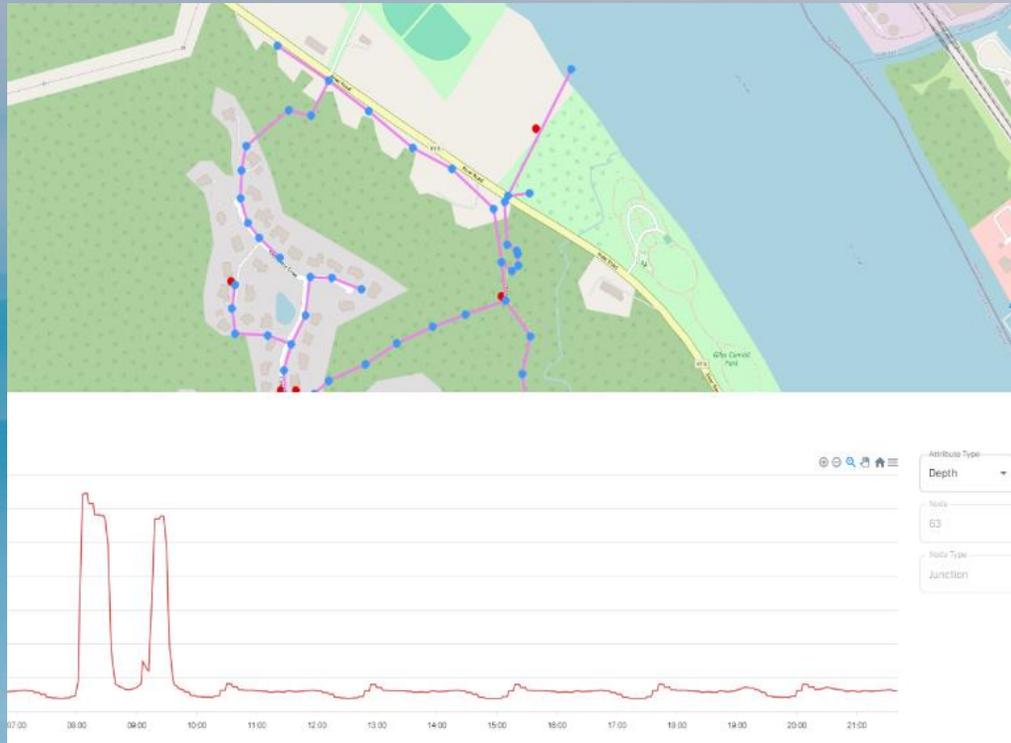
- Provides insights into the complex interrelationships between the hydraulic grade, the flows, the water quality and the incidents such as SSO's and CSO's.

- The 3D visualization improves spatial understanding and highlights any assets geographic data discrepancies compared to the ground truth.

- Lowers incident count and shows opportunities for improving storage utilization

- Increases the resilience through the modeling of the impact of what-if catastrophic events

# Wastewater Collection System Asset Risk Assessment (WCSRA) : Overview
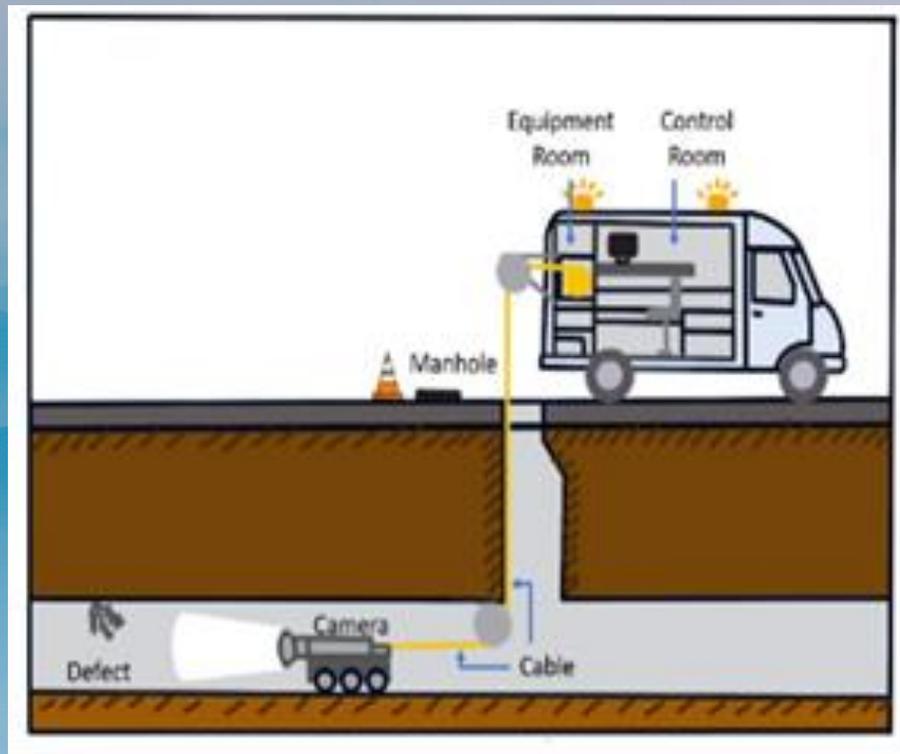
- AI-driven Computer Vision (CV) for automated detection of defects in sewer CCTV footage.

- Machine Learning (ML)-based prediction of defect locations in uninspected assets with high accuracy.

- Quantifiable business risk reduction by preventing catastrophic failures, reducing Inflow & Infiltration (I&I), and improving network performance.

- Proven validation across multiple North American utilities.

- CV models designed for QA/QC of existing inspection reports or generation of new reports from video footage.

- ML models that support optimized inspection scheduling and asset maintenance planning.

- Developed using the Supercomputing Cluster at the University of British Columbia (UBC) for high-performance analytics.

# Wastewater Collection System Asset Risk Assessment (WCSRA) : Features

- Functionality to apply off-the-shelf HydroTrek CCTV CV models without developing a custom model

- Requires zero data preparation. The videos are processed by the CV pipeline. Advanced Optical Character Recognition (OCR) extracts information from the videos.

- Handles PACP and wRC codes and has tolerance for noisy data.

- Faster training times for custom CV and ML models using GPU's.

- Advanced ML and GIS-based defect location prediction functionality to prioritize future inspections.

# Wastewater Collection System Asset Risk Assessment (WCSRA) : Advantages
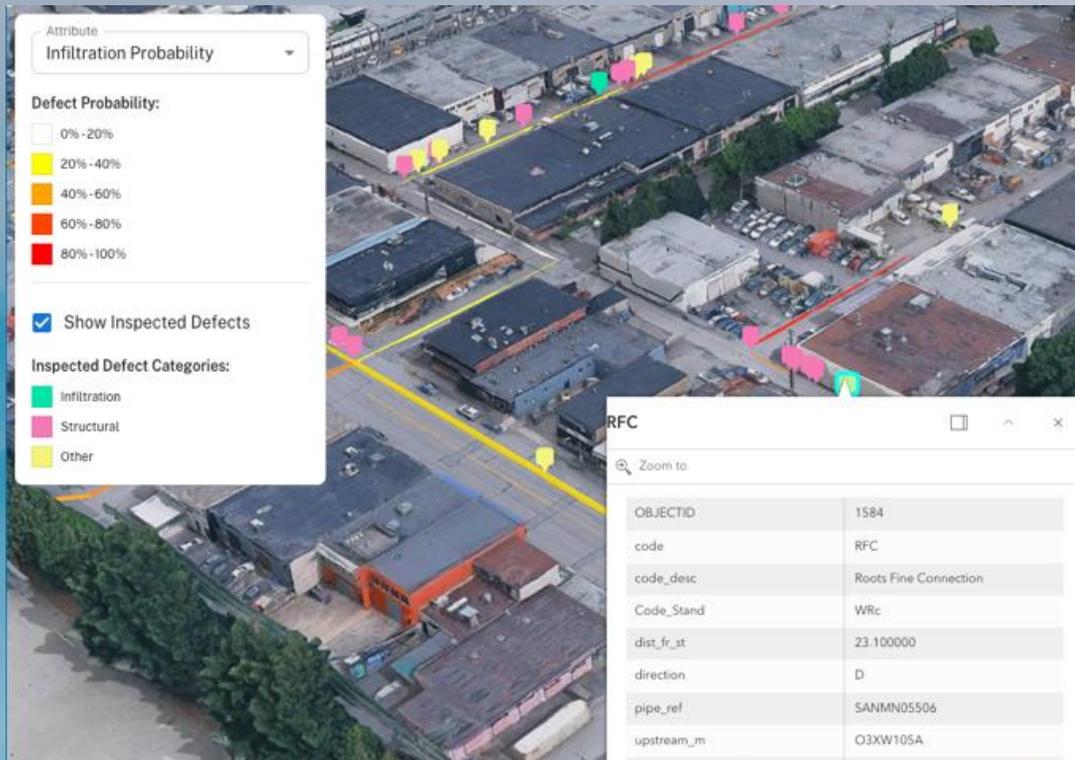
- The CV model can be used to train new staff, to QA/QC old and new inspection reports, to process the no-annotation videos from sewer CCTV robots.

- The multiple CV models approach allows the prediction of a specific defect or a particular defect class such as I&I. Other CCTV CV approaches provide a single defect label.

- The inspected and predicted defects can be displayed in a 2D and 3D GIS visualization to improve system understanding and to highlight any anomalies.

Source water?
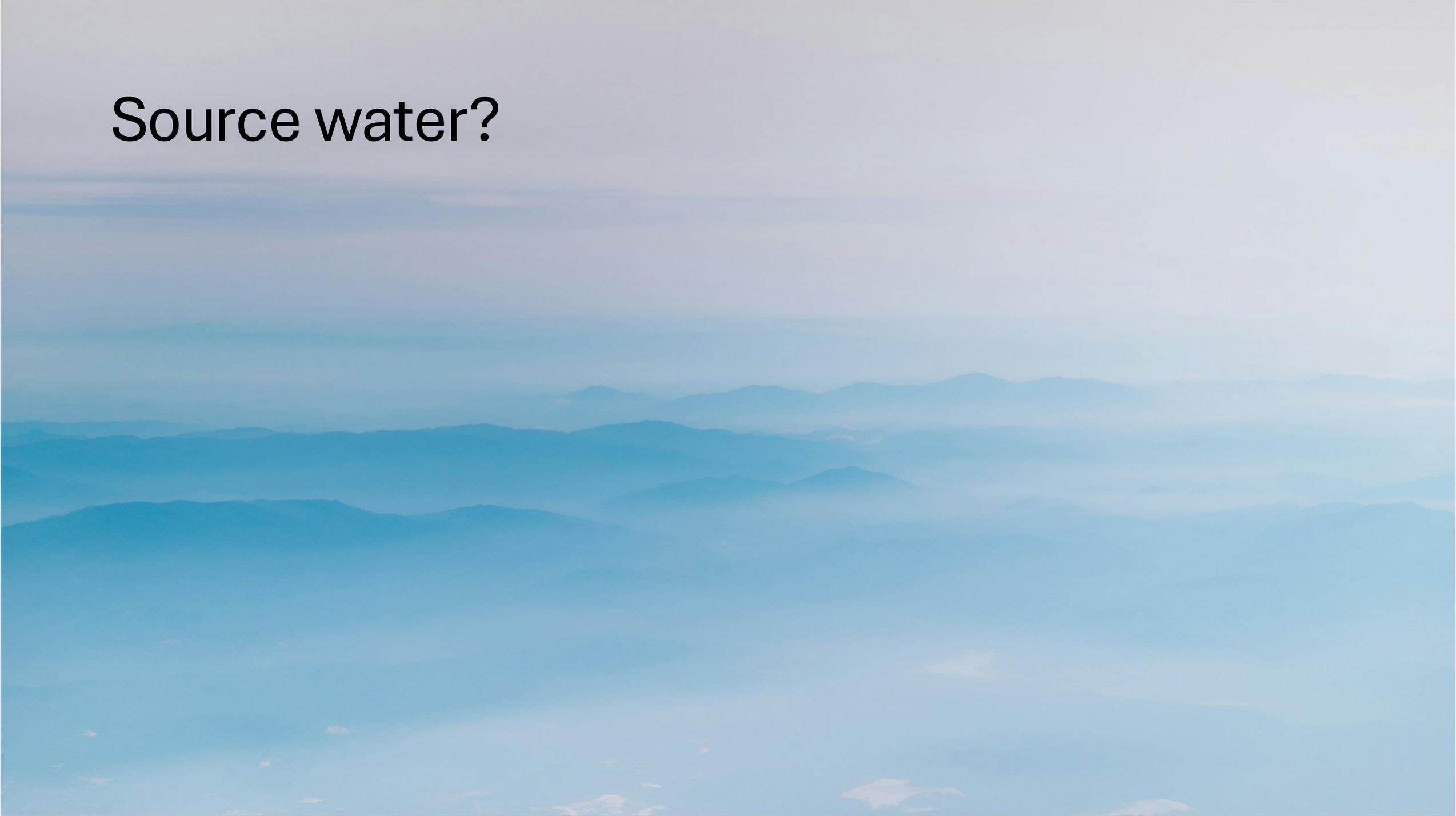
Stormwater Runoff Simulation (SRS) Software-as-a-Service : Overview
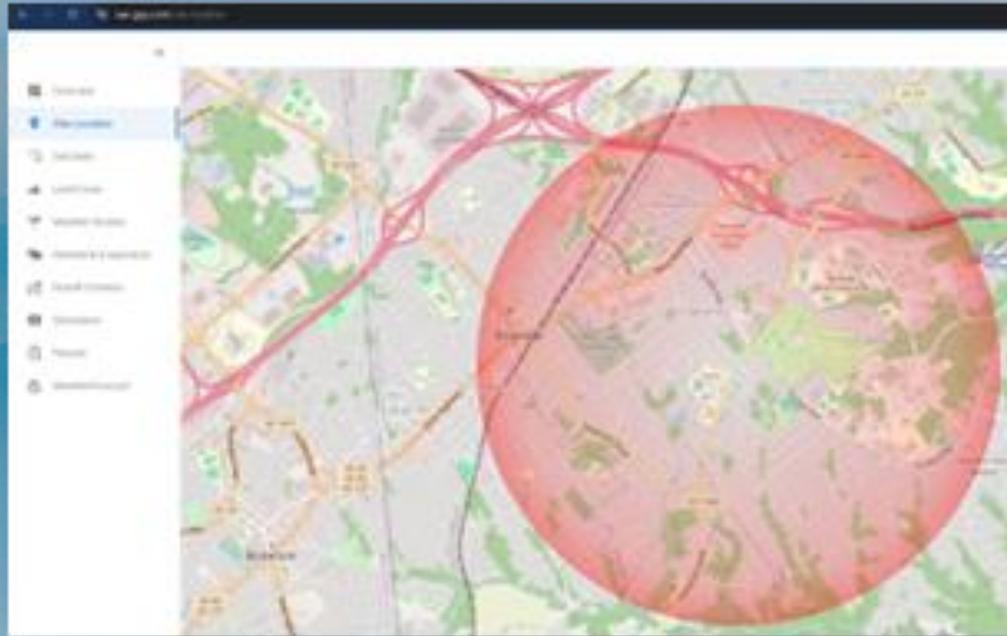
- The HydroTrek SRS is a leading software-as-a-service (SaaS) browser-based software platform that requires zero download of data to your desktop.

- Has been successfully tested at multiple areas in the United States. The SRS uses the information from multiple US Government Agencies to create the stormwater model in real-time and accurately calculates the system runoff in a variety of scenarios that include different LID controls. The SRS uses the US EPA SWMM engine for the core calculations and provides high quality results.

- The web-based software works well on multiple hardware platforms that include desktops, notepads and smartphones. A variety of LID implementation scenarios can be simulated quickly and compared to assist decision-making.

# Stormwater Runoff Simulation (SRS) Software-as-a-Service : Features

- Simulates stormwater runoff at any location in the United States.

- Extracts needed soil data, slopes, landcover, rainfall data and evaporation from US Government agencies through web API calls.

- Constructs the LID controls selected by the user

- Calculates the runoff for the specified simulation duration.

- Displays the results in a user-friendly interface

Stormwater Runoff Simulation (SRS) Software-as-a-Service : Advantages

Scenario	Description	Runoff Depth (inches)	Run-off Volume (acre-ft)	Run-off Volume (million gallons)	% Runoff reduction	Reduction in Run-off Volume (million gallons)
Pre Development	67 % Forest, 0 % Impervious	6.40	274.67	90		
Post Development	38 % Forest, 29 % Impervious	14.88	638.6	208		
#1 Rain Barrel	55 gallon, all rooftops captured, 2 rain barrels per 1,000 sq.ft.	11.88	509.85	166	20.11	**42**
#2 Cistern	300 gallon, all rooftops captured, 1 cistern per 1,000 sq.ft.	11.80	506.42	165	20.66	**43**
#3 Rain Garden	15 % Capture ratio, all rooftops captured, 12" Soil Media Thickness	12.43	533.45	174	16.44	**34**
#4 Rain Garden	25 % Capture ratio, all rooftops captured, 18" Soil Media Thickness	11.67	500.84	163	21.56	**45**
#5 Rain Garden	25 % Capture ratio, 1/3rd Roof Tops Captured, 18" Soil Media Thickness	14.00	600.83	196	5.92	**12**

- Provides an extremely easy-to-use browser-based interface to simulate stormwater runoff under different stormwater control scenarios.

- The rapid exploration improves the understanding of the hydrological and geological characteristics coupled.

- Provides the determination of historical runoff using the long rainfall histories from weather stations.

- Increases the resilience knowledge through the modeling of the impact of climate change.

Flood Damage Assessment and Risk Management (FDARM) : Overview
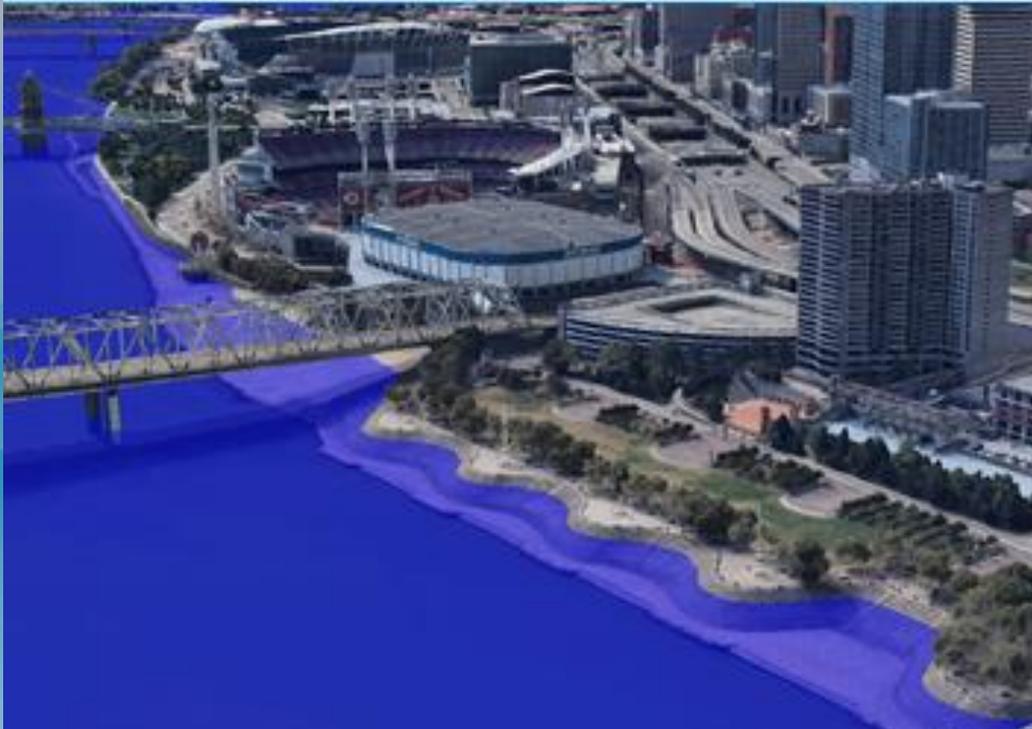
- Flood visualization in 3D using Augmented Reality (AR) through a slider to change water elevation

Flood Damage Assessment and Risk Management (FDARM) : Features

- Interactive water-elevation slider to explore varying inundation levels and potential damage zones.

- Immersive visualization using Google tiles for a photorealistic view, showing city-scale models of structures, flora and water bodies.

- Advanced AI driven flood detection using images and videos from CCTV and traffic cameras.

- Dynamic simulation engine powered by HEC-RAS for precise 1D/2D and 3D modeling.

- Augmented Reality (AR) driven visualization tools to evaluate risk, response strategies, and infrastructure impacts

Flood Damage Assessment and Risk Management (FDARM) : Advantages

- Allows for tabletop exercises resulting in better emergency preparedness.

- Reduces response times and supports proactive flood mitigation.

- Builds resilience through predictive modeling of catastrophic scenarios.

- Identifies at-risk infrastructure, strengthens long-term flood mitigation strategies, and builds resilient communities.