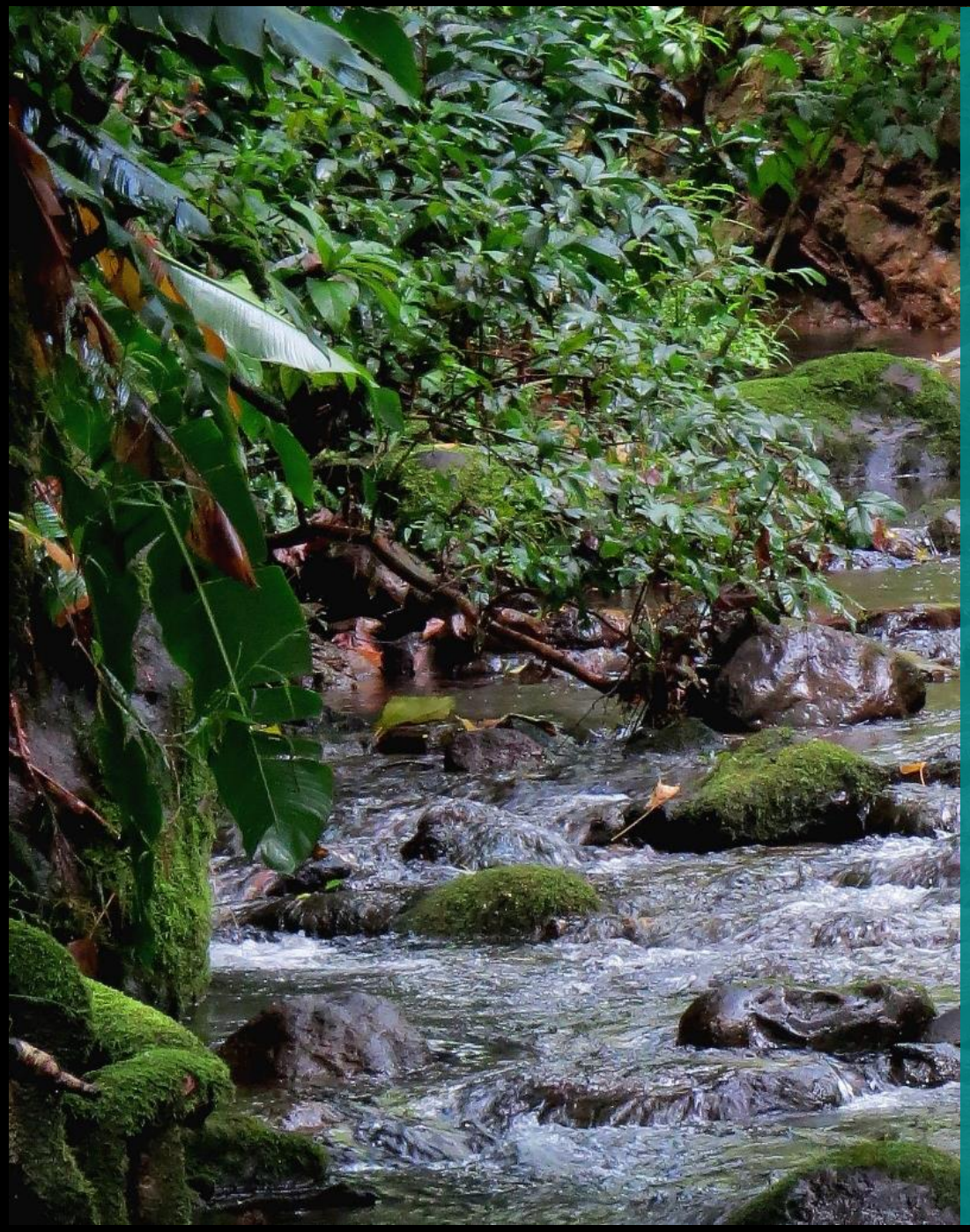


PIPE DREAMS: OPTIMIZING PIPELINE REHAB AND REPLACEMENT

Isaac Hayashi & Tony Shing

October 15, 2025

HWWA 2025 Conference

AGENDA

- Pipeline Replacement Priorization Overview
- Risk Model Overview
- Workflow and GIS Processing
- Current Process and Looking Ahead

PIPELINE REPLACEMENT PRIORITIZATION

- Island-wide prioritization of pipeline replacement based on risk
- Utilizing GIS and Hydraulic Modeling to identify “high risk” pipes
- Create pipeline replacement projects based on risk results

OVERALL PROCESS

Risk Model

InfoAsset

Project Build Tool

KOHOLA

Capital Improvement Project Database

CIP OutSystems Database

Project Tracking DB

MANAO

GIS Layer Showing Project Status

Project Mains Layer

Completed Projects Back in GIS

HONU

RISK MODEL OVERVIEW

Risk Calculation

- Consequence of Failure (COF)
- Likelihood of Failure (LOF)

Risk by Grading

- Risk Matrix
- Negligible to Extreme

Decision Framework

- In CIP
- Inspection
- No Action
- Replace

Hot Spot

- Create cluster of pipes based on Risk Scores and Decision Framework Outcome

KOHOLA

- Build projects based on Risk and Hot Spots

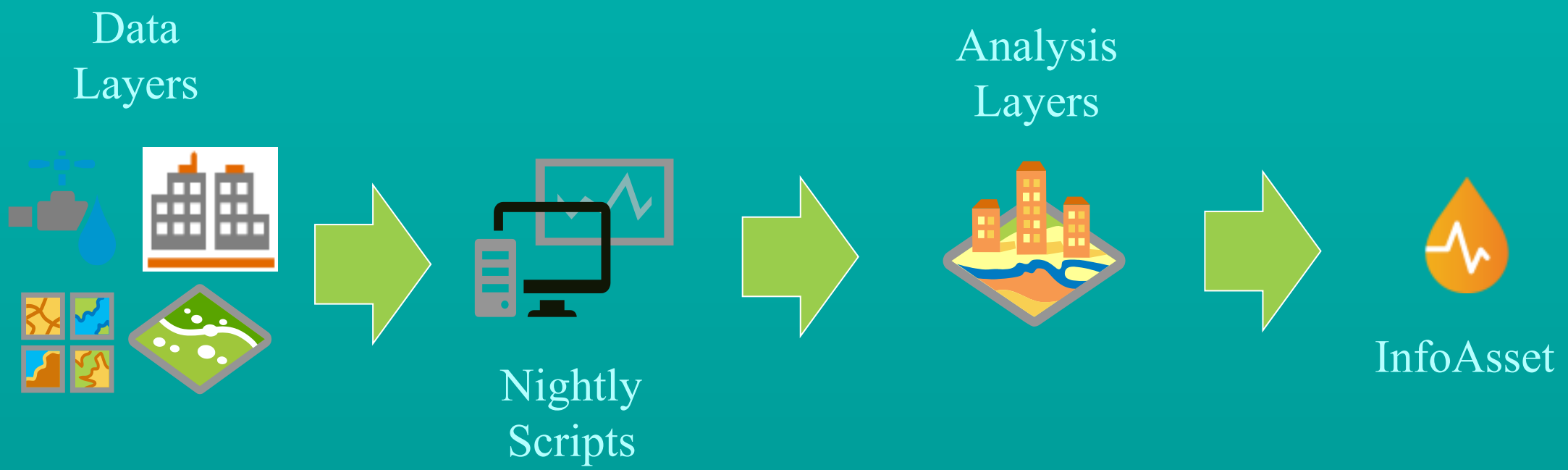
RISK CALCULATION

Risk = Consequence of Failure (COF) x Likelihood of Failure (LOF)

CONSEQUENCE OF FAILURE

- COF: Determine the impacts of a particular water main breaking
  - Various Characteristics Considered
    - Disruption, Damage, Traffic Volume, Outage, Water System Performance Impacts, and Density

GIS PROCESSES TO SUPPORT MODEL



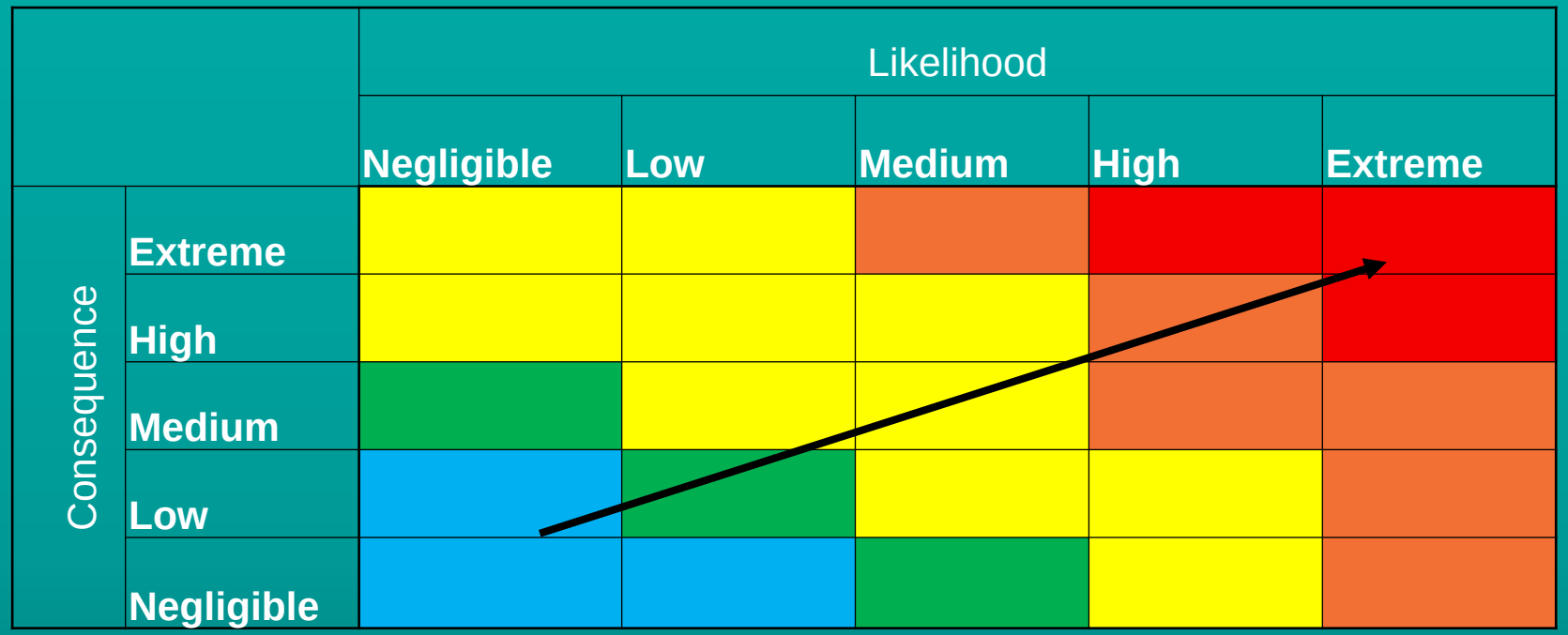
Various data layers used to create the COF and LOF are pulled and massaged via nightly scripts to create the summarized analysis layers in the correct format ready for InfoAsset to consume

LIKELIHOOD OF FAILURE

- LOF: Determine how likely a particular water main will break
- Based on various characteristics, determine a predictive break number for a given pipe
  - Age, Soil, Diameter, Pressure, Previous Breaks, etc…
- Different Potential Models
  - Statistical Model (Casses – LEYP) - Linear Regression Model
  - Machine Learning Model - Pilot utilizing machine learning to better calculate the likelihood of failure factors for water mains

BWS RISK MATRIX

- Risk by Grading:
  - Negligible – (1)
  - Low – (2)
  - Medium – (3)
  - High – (4)
  - Extreme – (5)



RISK EXAMPLES

		Likelihood				
		Negligible	**Low**	**Medium**	**High**	**Extreme**
Consequence	**Extreme**					
	High					
	Medium					
	Low					
	Negligible					

Low COF – minimal services, dead end street, small diameter

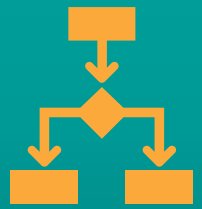
High LOF – old pipe, a lot of breaks

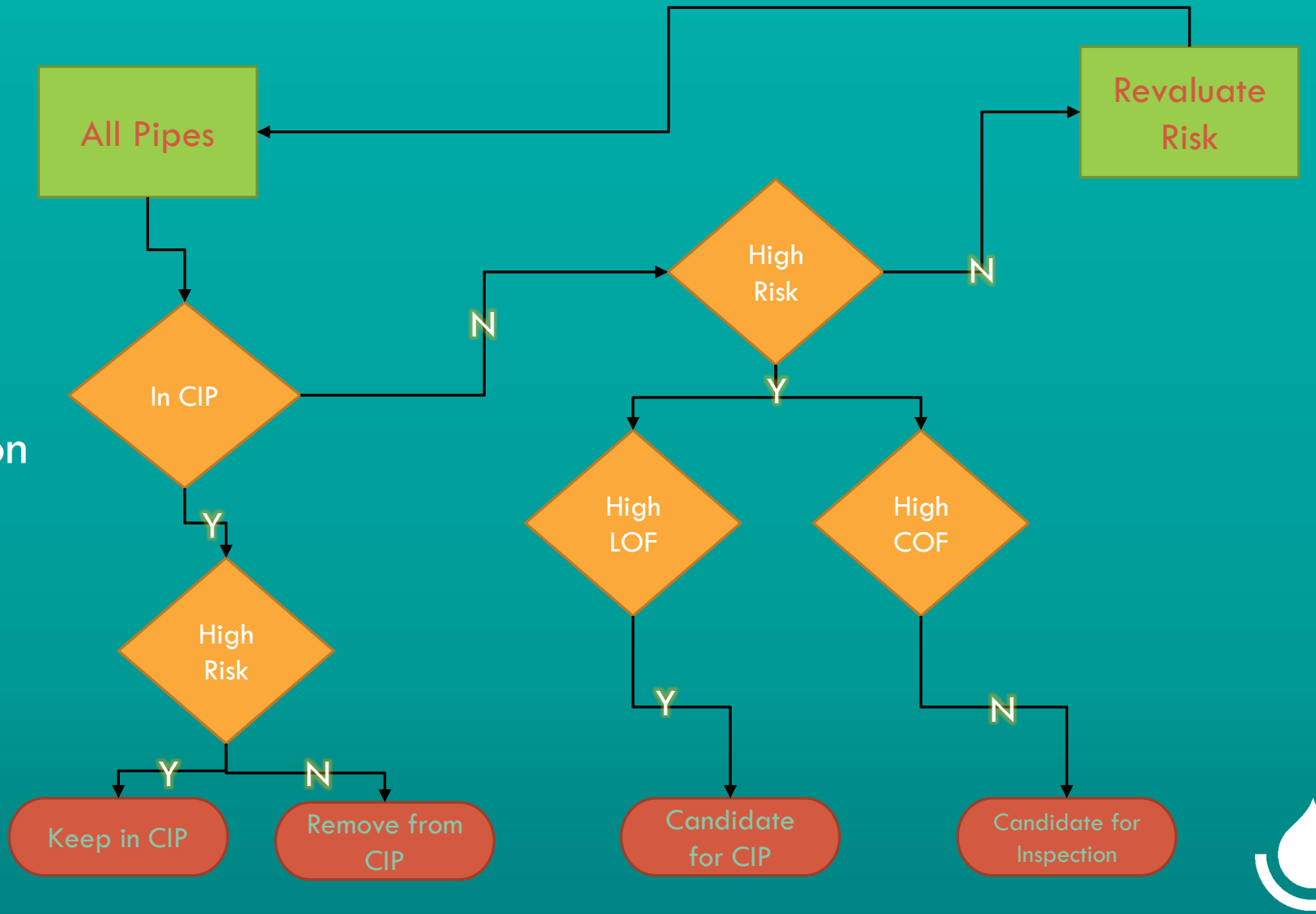
High COF – busy roadway, serves hospital, large diameter

Low LOF – new pipe, no break history

REHAB FRAMEWORK

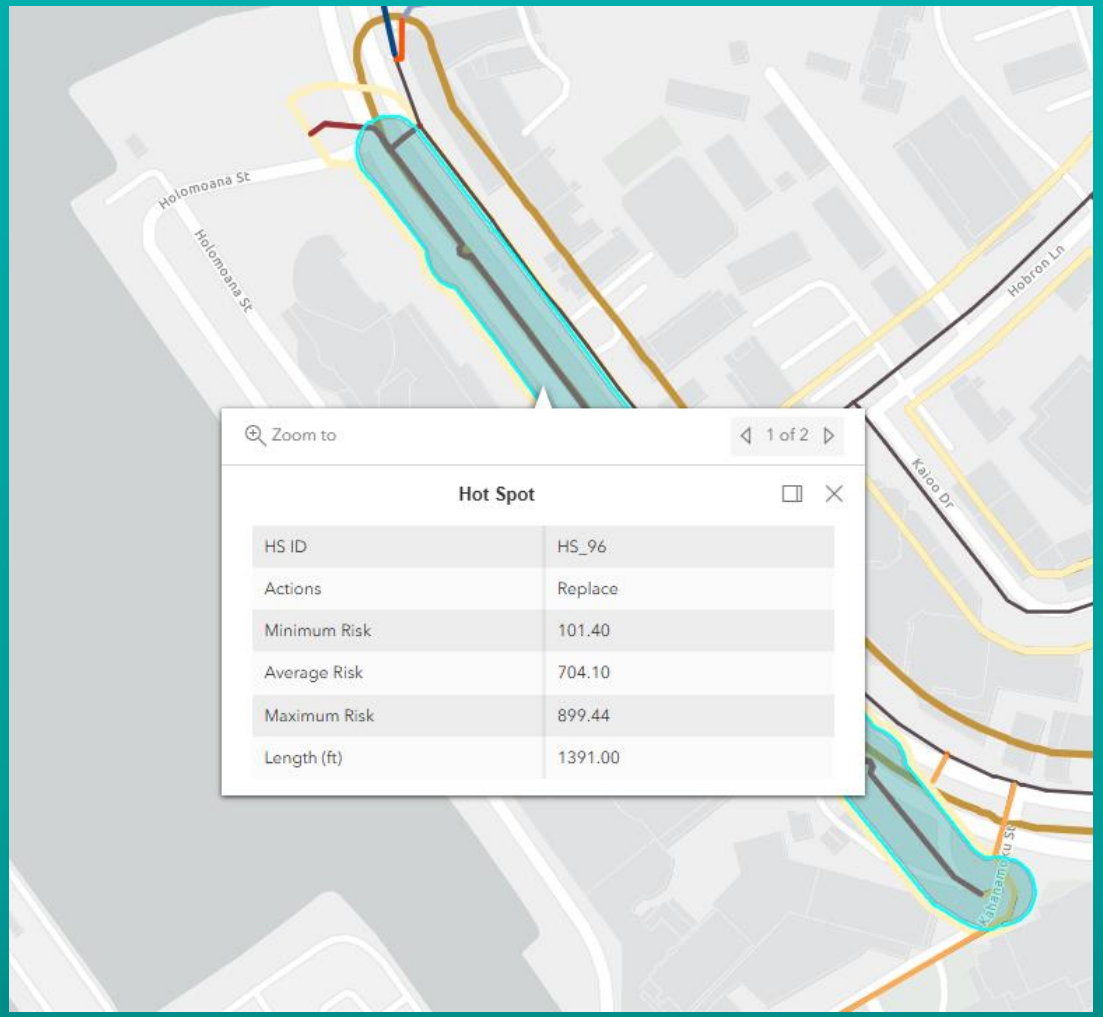
Apply logic to drive action



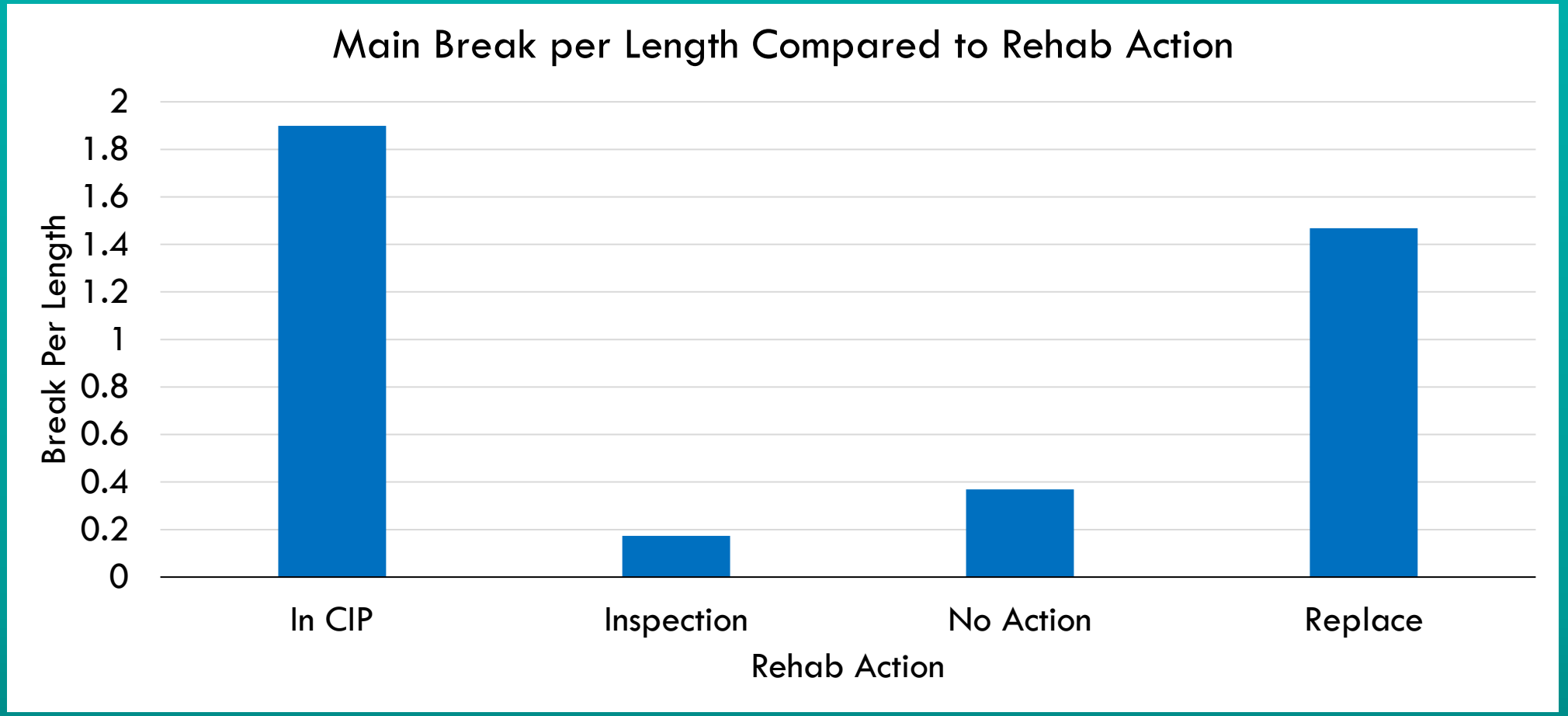


HOT SPOTS

- Help identify groups of pipes that should be turned into projects
- This was generally based on high risk and identified pipes for replacement.



OVERALL PROGRESS



CREATING PROJECTS FROM RISK MODEL DATA

OVERALL PROCESS

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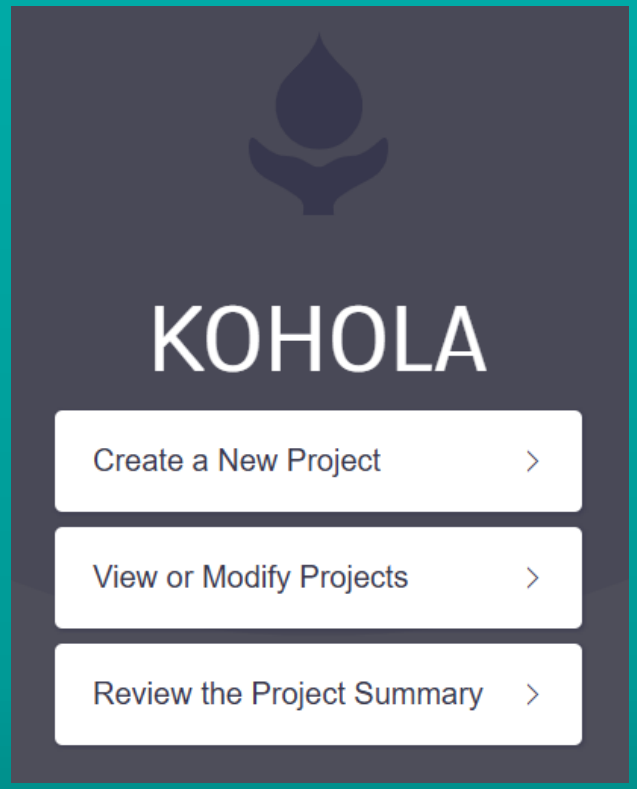
HONU

KOHOLA

- KOHOLA is a custom web-application developed to view risk results for pipeline replacement.
- Simple UI to select and create projects
- Project summary and draft and planned project tracking
- Print project map



WORKFLOW - KOHOLA

InfoAsset Results Import to KOHOLA

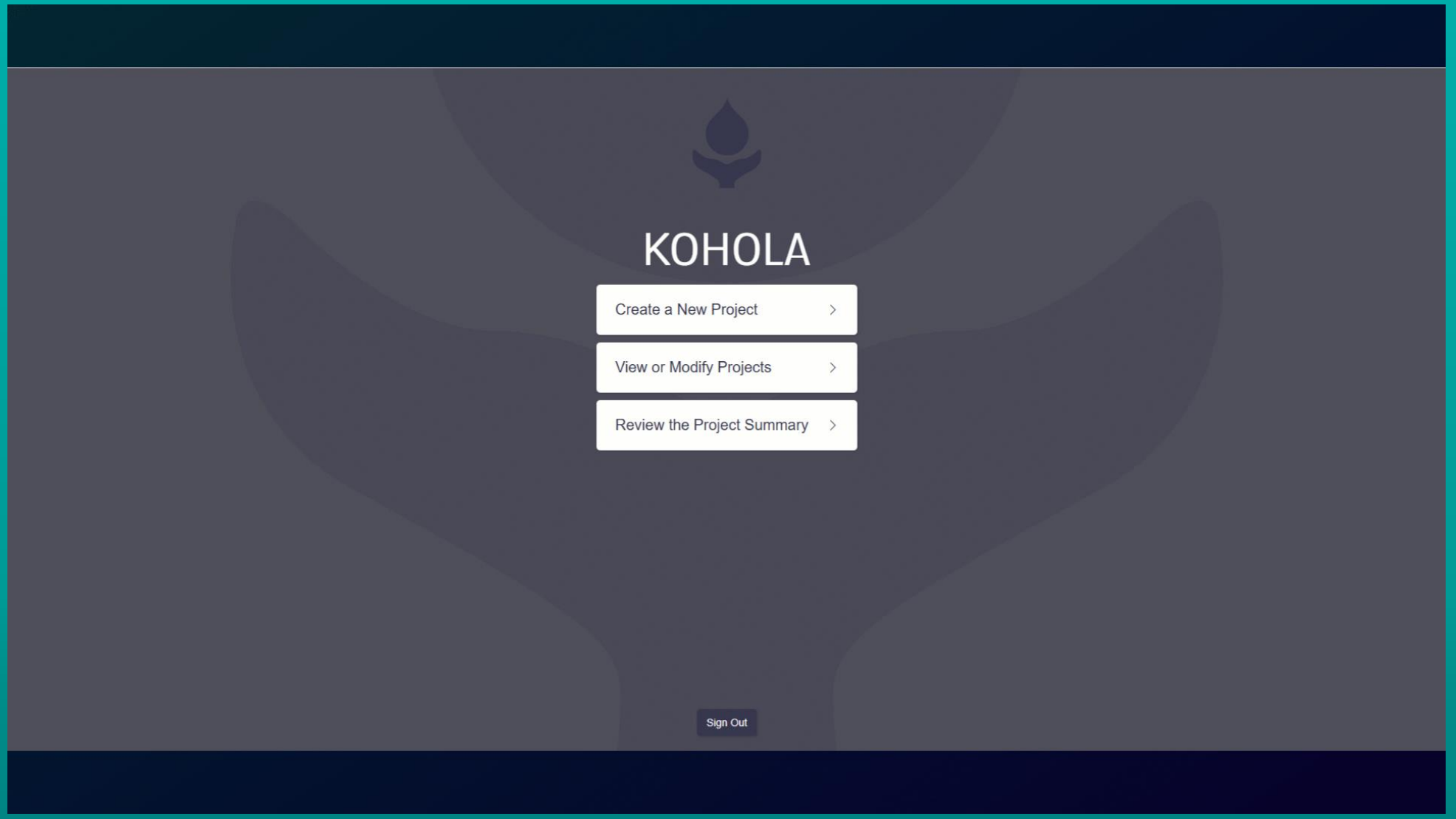
Project Build with KOHOLA

Projects tie to 6 year CIP List

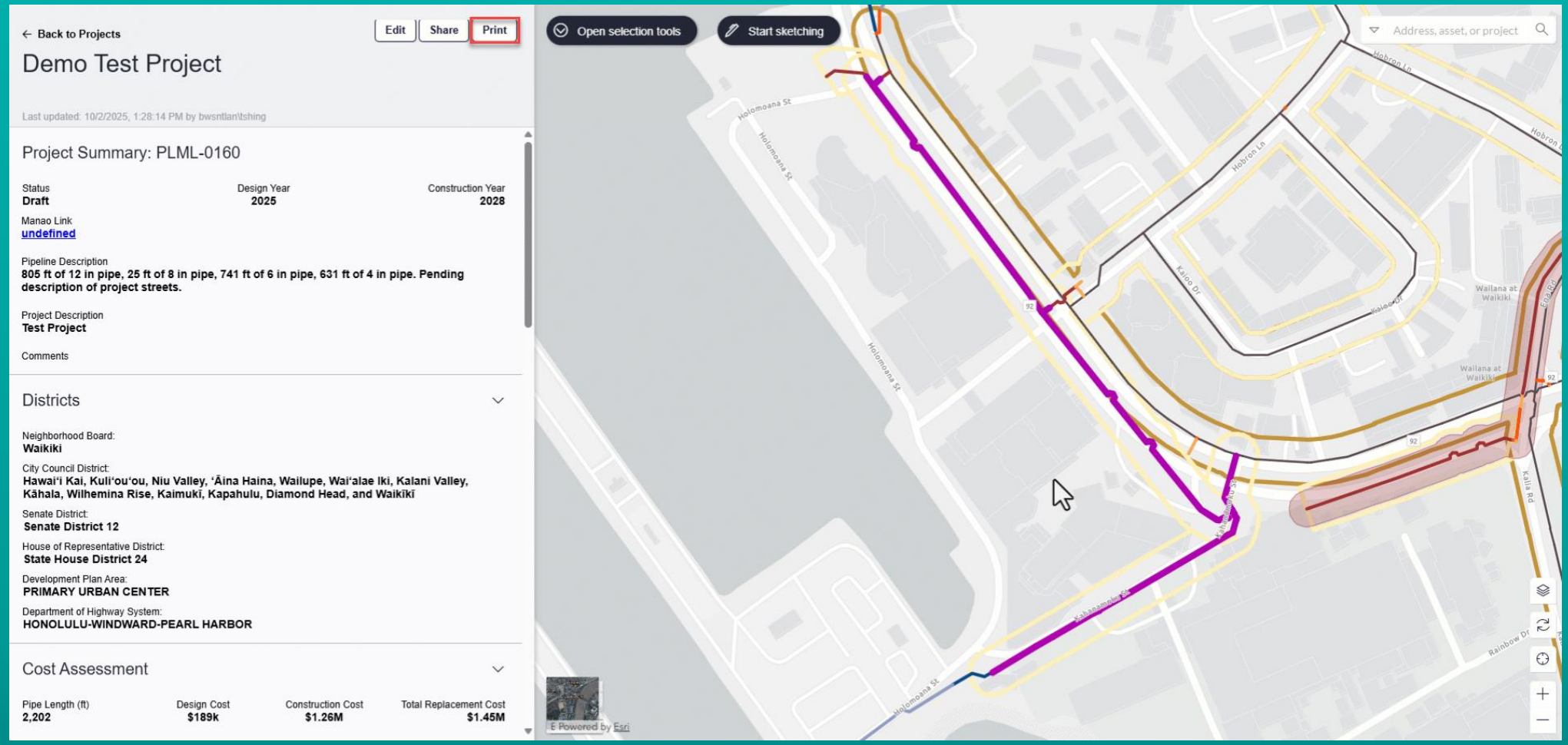
Project Revision done in KOHOLA

Once Planned project is ready –will feed into Capital Project DB and Projects Mains Layer in the GIS

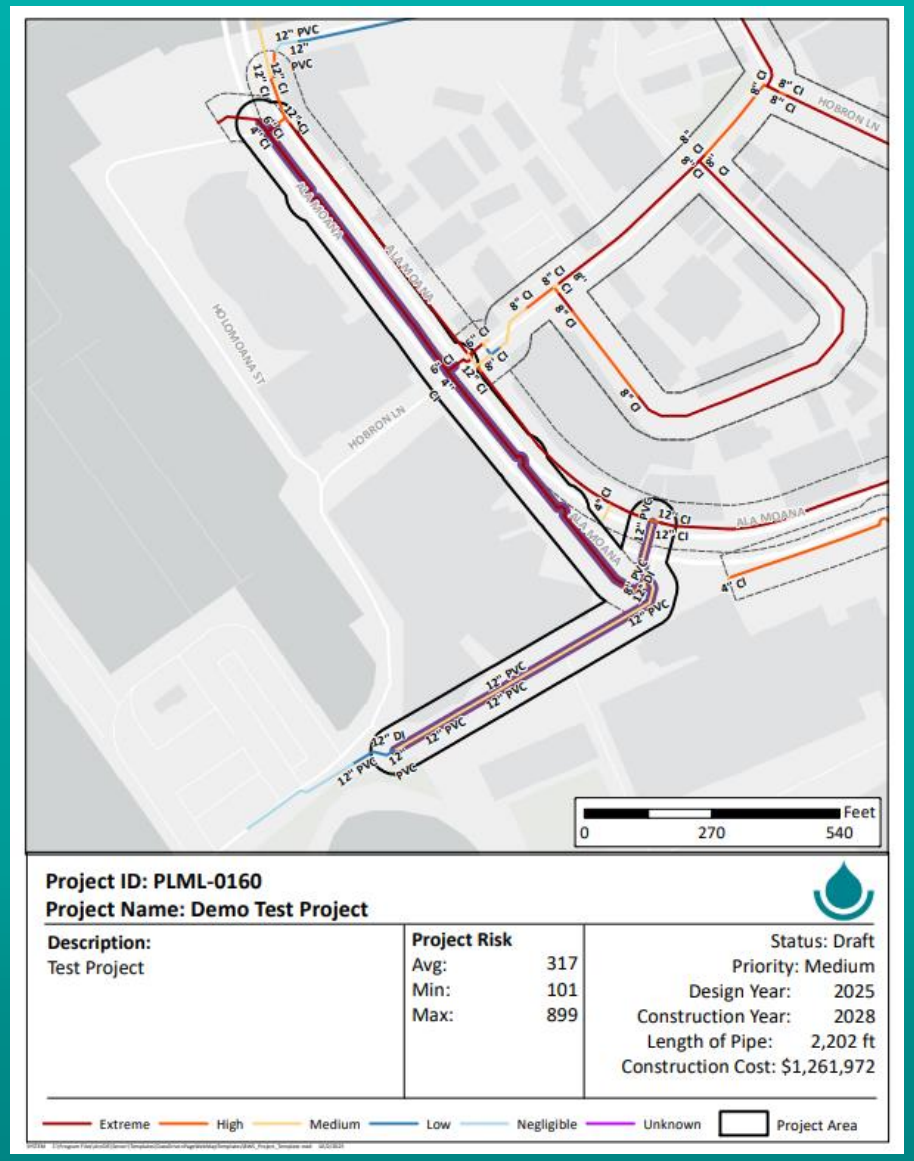
KOHOLA DEMO

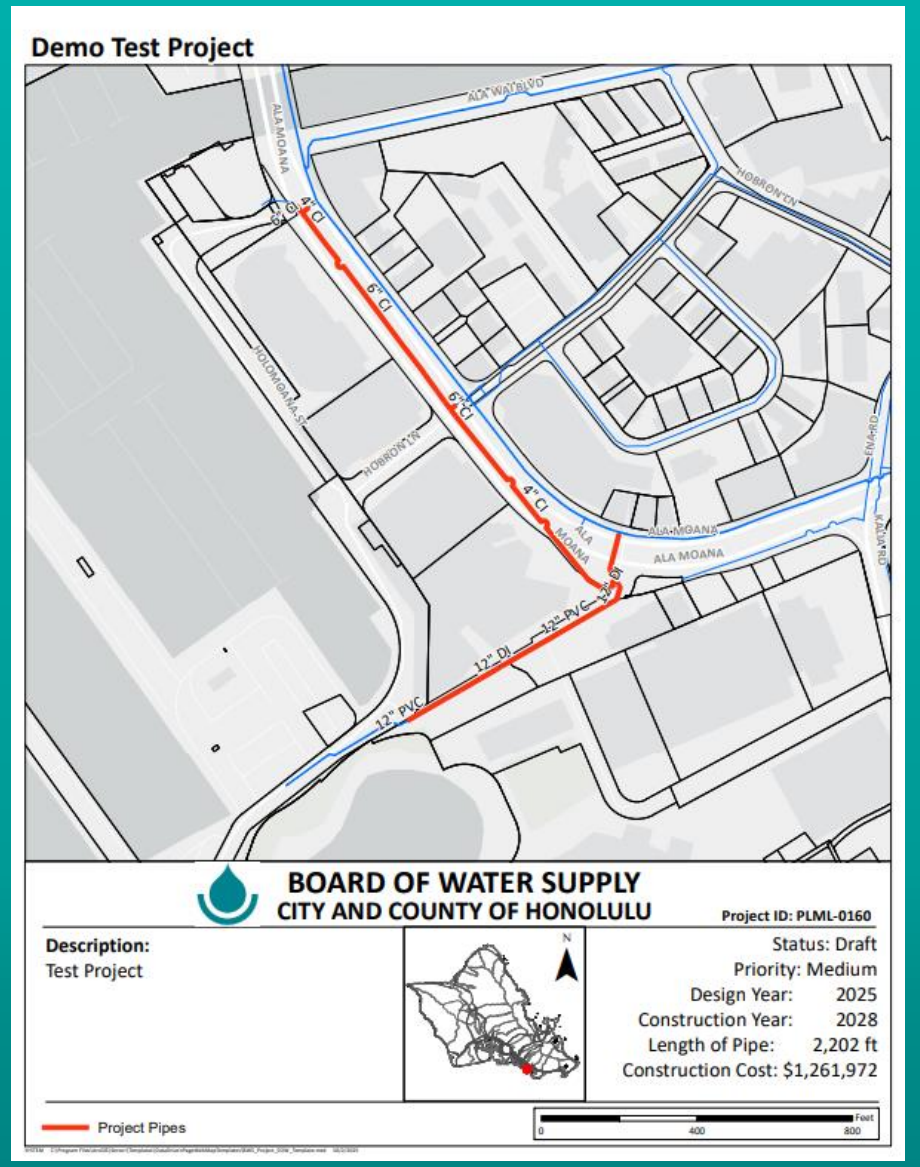

KOHOLA
Create a New Project
View or Modify Projects
Review the Project Summary
Sign Out

KOHOLA DEMO


Back to Projects
Edit
Share
Print
Demo Test Project
Last updated: 10/2/2025, 1:28:14 PM by bwsntlan\tshing
Project Summary: PLML-0160
Status
Draft
Design Year
2025
Construction Year
2028
Manao Link
undefined
Pipeline Description
805 ft of 12 in pipe, 25 ft of 8 in pipe, 741 ft of 6 in pipe, 631 ft of 4 in pipe. Pending description of project streets.
Project Description
Test Project
Comments
Districts
Neighborhood Board:
Waikiki
City Council District:
Hawai'i Kai, Kuli'ou'ou, Niu Valley, 'Āina Haina, Wailupe, Wai'alae Iki, Kalani Valley, Kāhala, Wilhemina Rise, Kaimukī, Kapahulu, Diamond Head, and Waikīkī
Senate District:
Senate District 12
House of Representative District:
State House District 24
Development Plan Area:
PRIMARY URBAN CENTER
Department of Highway System:
HONOLULU-WINDWARD-PEARL HARBOR
Cost Assessment
Pipe Length (ft)
2,202
Design Cost
$189k
Construction Cost
$1.26M
Total Replacement Cost
$1.45M
Open selection tools
Start sketching
Address, asset, or project
Holomoana St
Hobron Ln
Kaloa Dr
Wailana at Waikiki
Kalia Rd
Rainbow Dr
Powered by Esri

PROJECT MAPS





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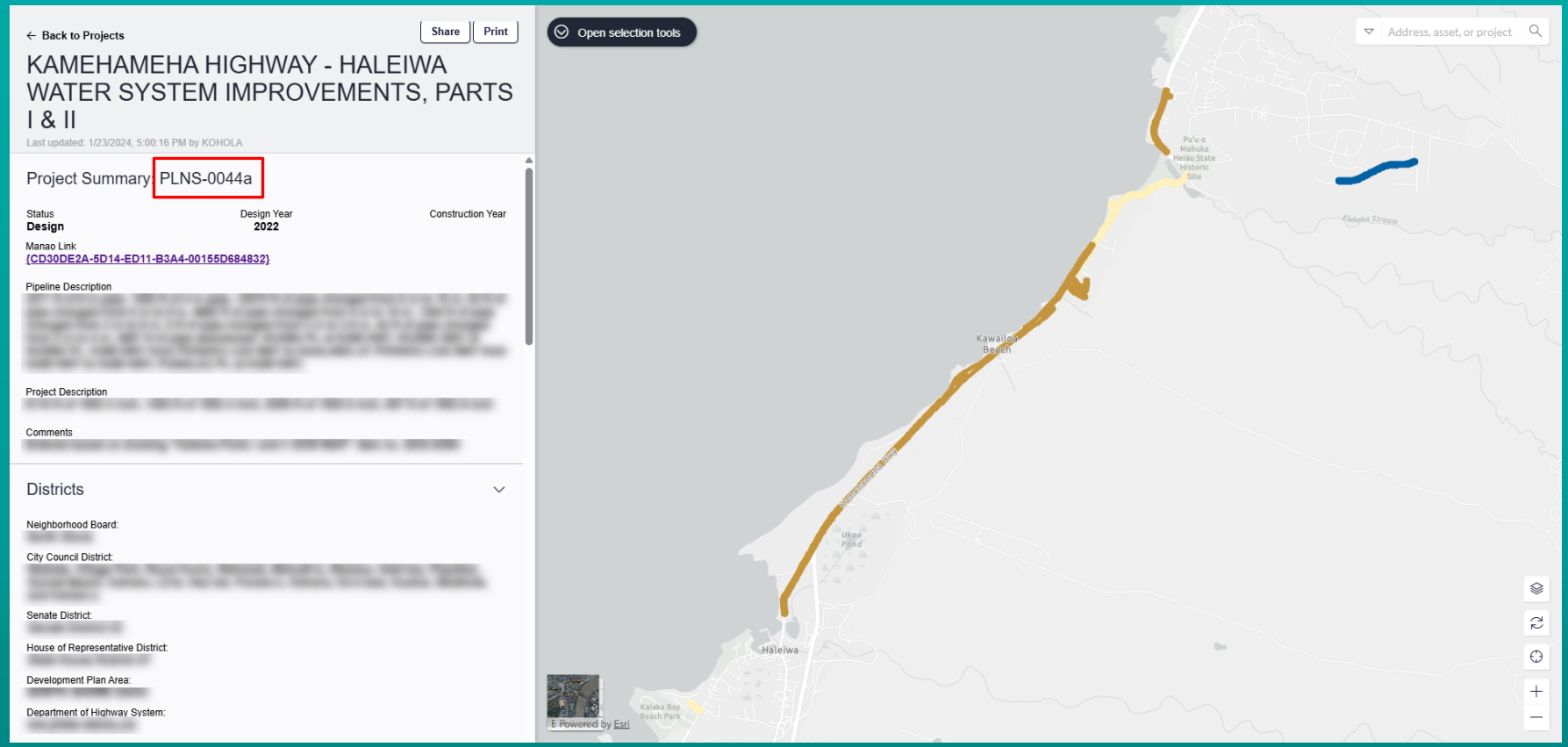
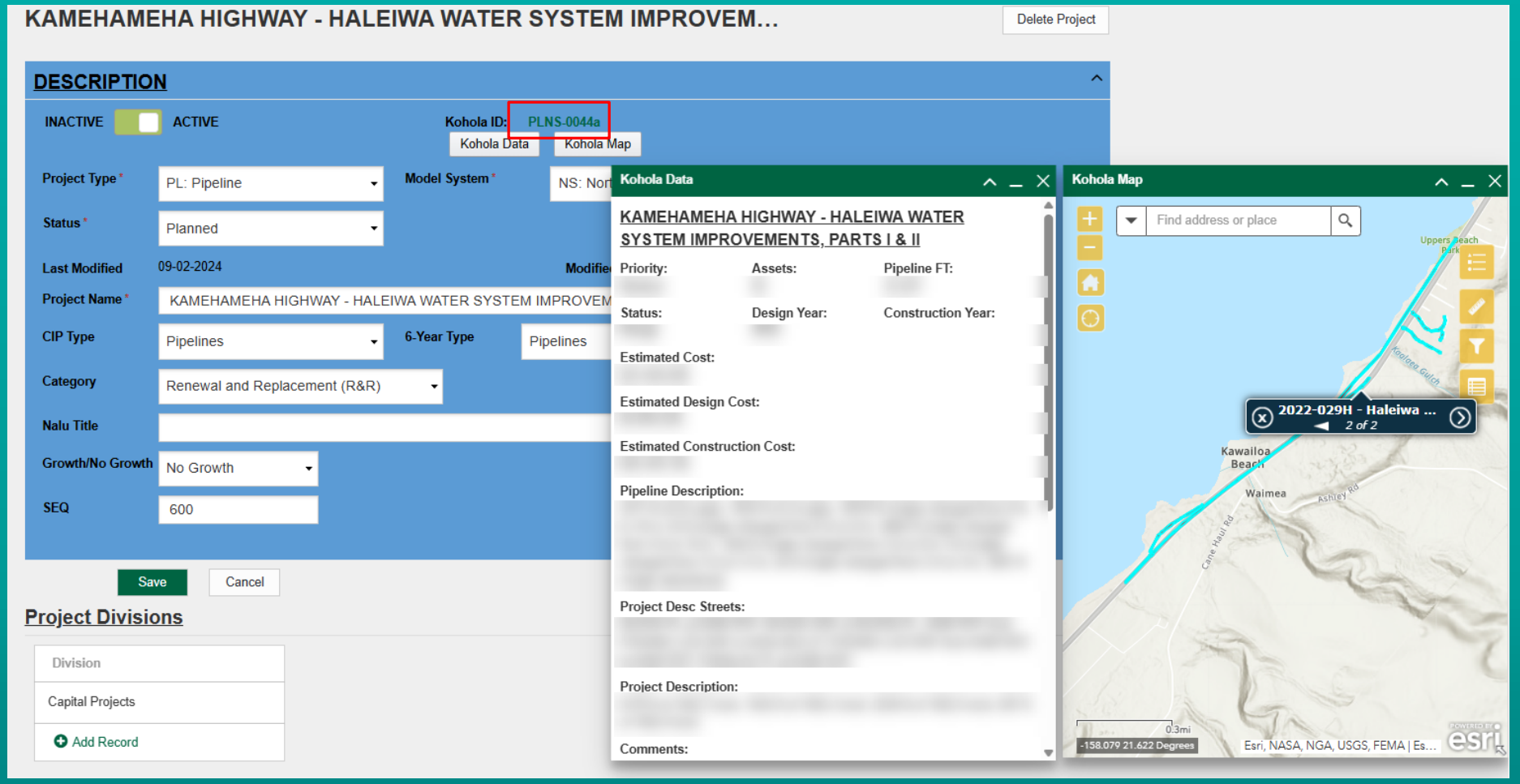
HONU

SYSTEM INTEGRATION

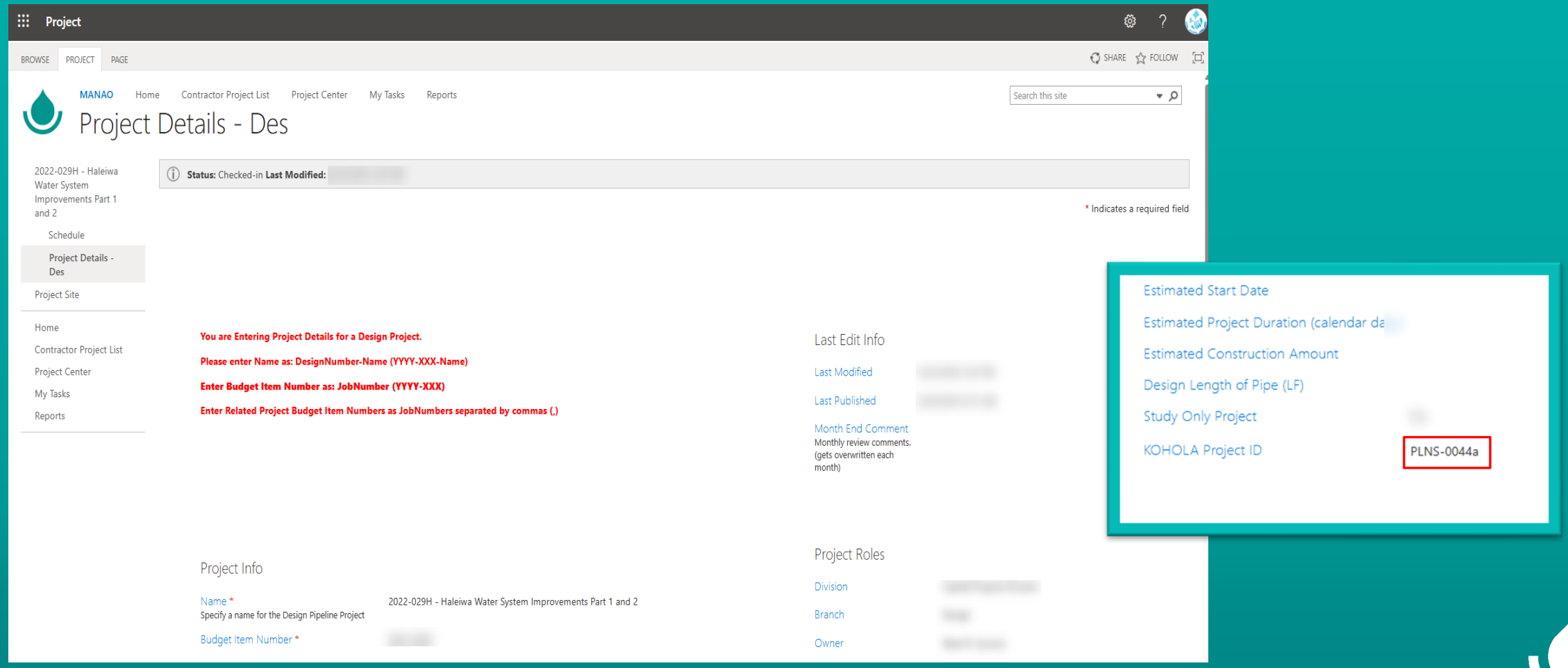
PLNS-0044a - Haleiwa Water System Improvements Part 1 and 2



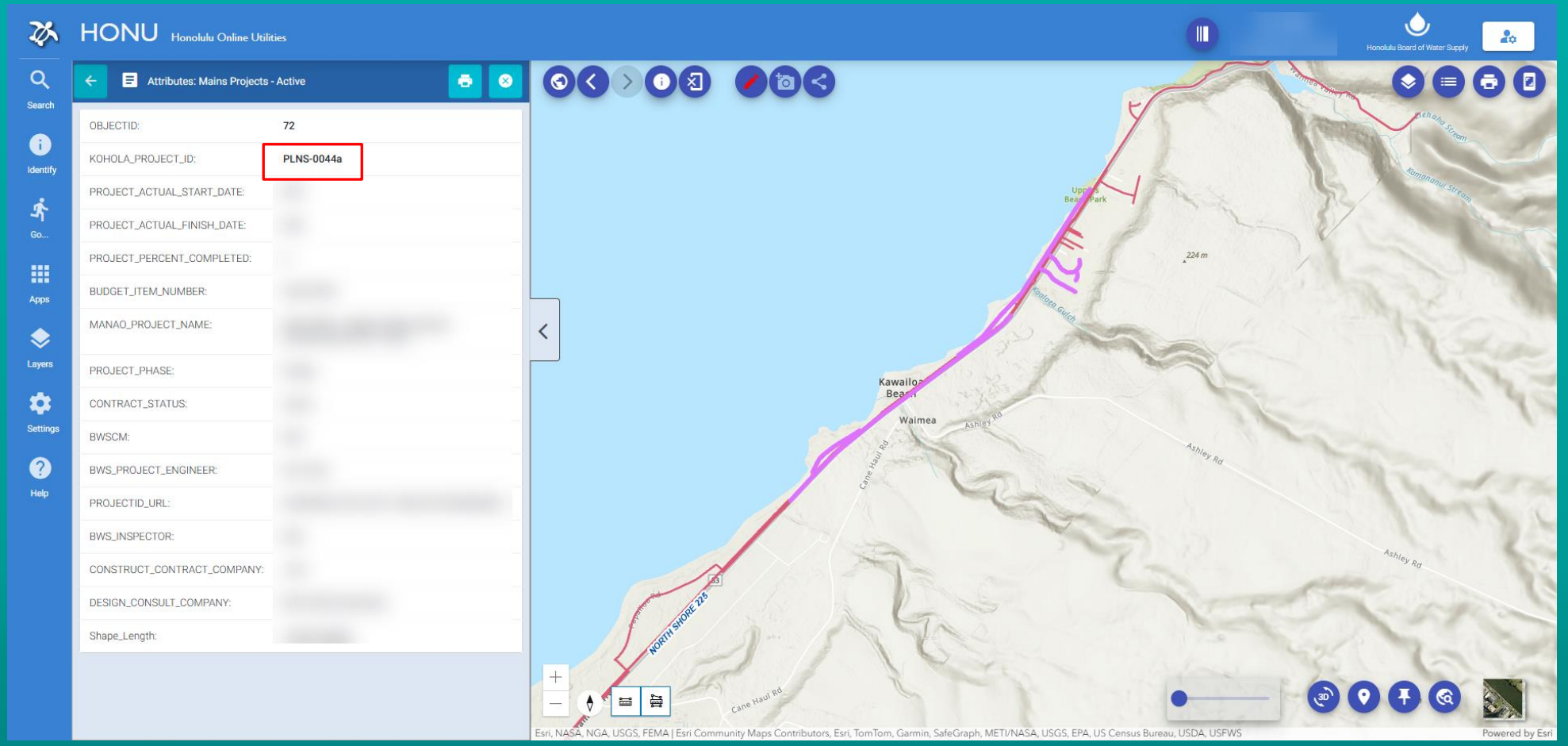
KOHOLA TO CIP OS



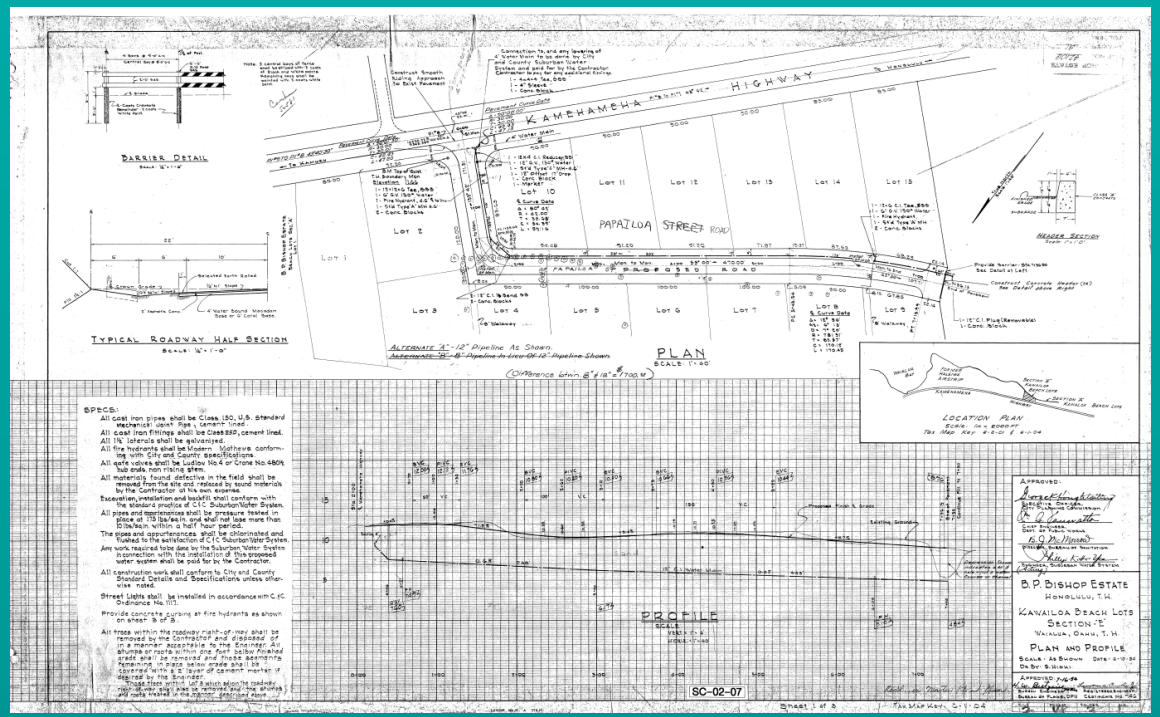
MANAO

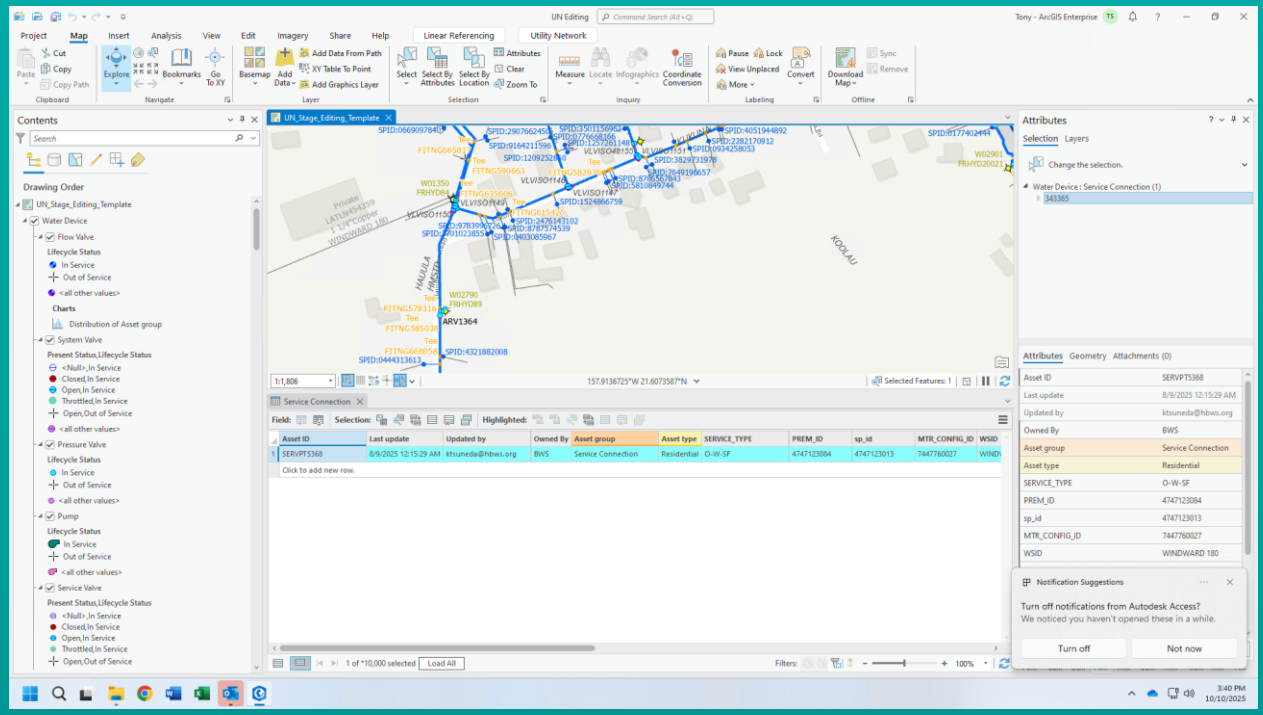

Project
BROWSE
PROJECT
PAGE
SHARE
FOLLOW
MANAO
Home
Contractor Project List
Project Center
My Tasks
Reports
Search this site
Project Details - Des
2022-029H - Haleiwa Water System Improvements Part 1 and 2
Schedule
Project Details - Des
Project Site
Home
Contractor Project List
Project Center
My Tasks
Reports
Status: Checked-in Last Modified:
* Indicates a required field
You are Entering Project Details for a Design Project.
Please enter Name as: DesignNumber-Name (YYYY-XXX-Name)
Enter Budget Item Number as: JobNumber (YYYY-XXX)
Enter Related Project Budget Item Numbers as JobNumbers separated by commas (,)
Last Edit Info
Last Modified
Last Published
Month End Comment
Monthly review comments. (gets overwritten each month)
Project Info
Name *
Specify a name for the Design Pipeline Project
2022-029H - Haleiwa Water System Improvements Part 1 and 2
Budget Item Number *
Project Roles
Division
Branch
Owner
Estimated Start Date
Estimated Project Duration (calendar da
Estimated Construction Amount
Design Length of Pipe (LF)
Study Only Project
KOHOLA Project ID
PLNS-0044a

PROJECT MAINS



BACK INTO GIS



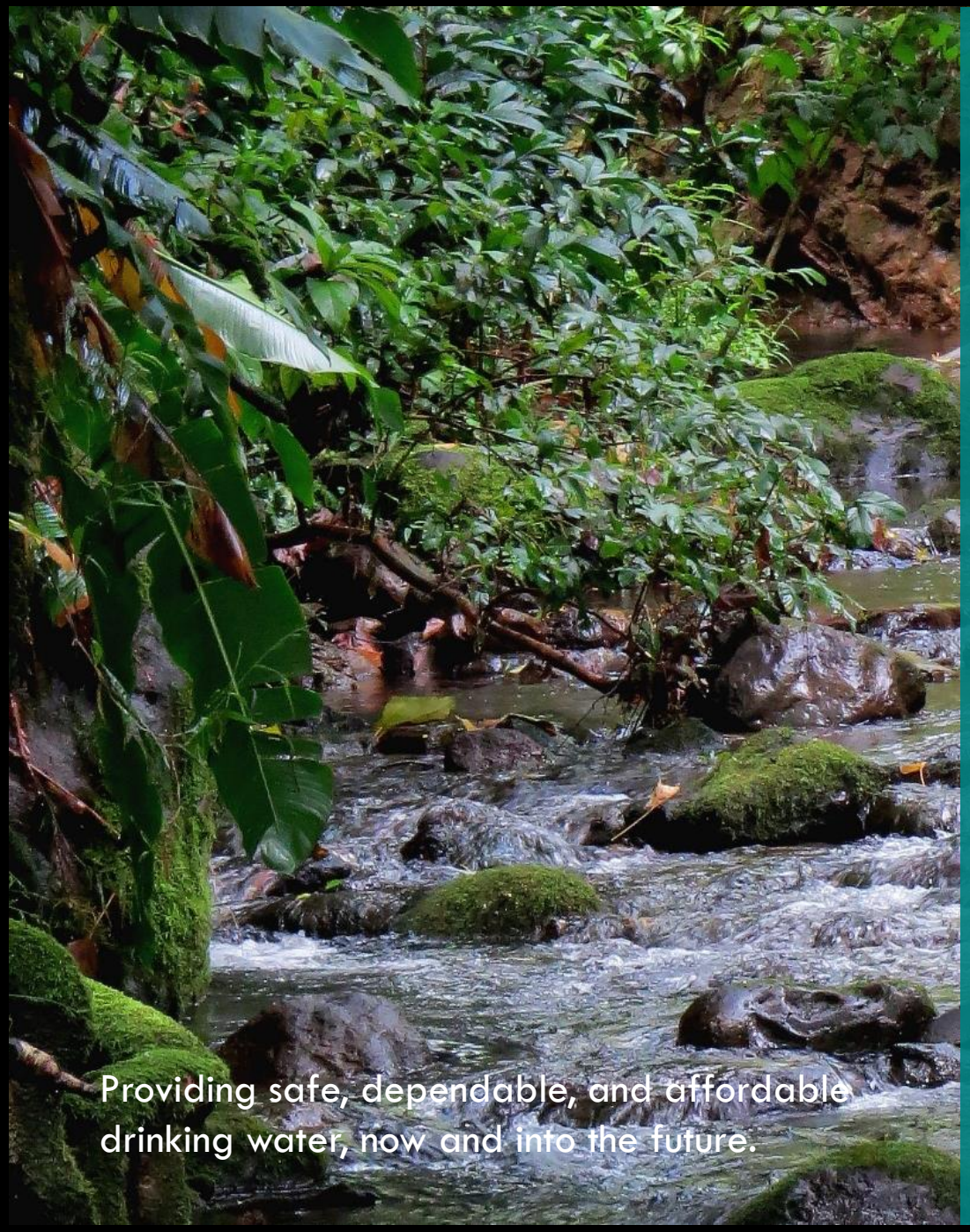


KEY TAKE AWAYS

- Good data
  - Break data
  - Pipeline
  - Hydraulic Model
- Keep a unique ID across systems
- Keep things simple
- Opportunity to update outdated processes

CURRENT PROCESS AND LOOKING AHEAD

- Currently in contract to conduct an update of the risk results using newer data
- Likelihood of Failure –
  - Look into further the use of AI and Machine Learning
  - Previous analysis used statistical modeling (linear regression)
- Overall, has provided a common platform for creating pipeline projects using a prioritization process which incorporates the various data and characteristics



Providing safe, dependable, and affordable drinking water, now and into the future.

Mahalo!

PIPE DREAMS: OPTIMIZING PIPELINE REHAB AND REPLACEMENT

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Tony Shing (tshing@hbws.org)