

PRELIMINARY CONCEPTUAL DESIGN

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Fisher Creek Basin
Ground Water Mitigation Program

June 23, 2014



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i n c o r p o r a t e d

SCOPE OF WORK

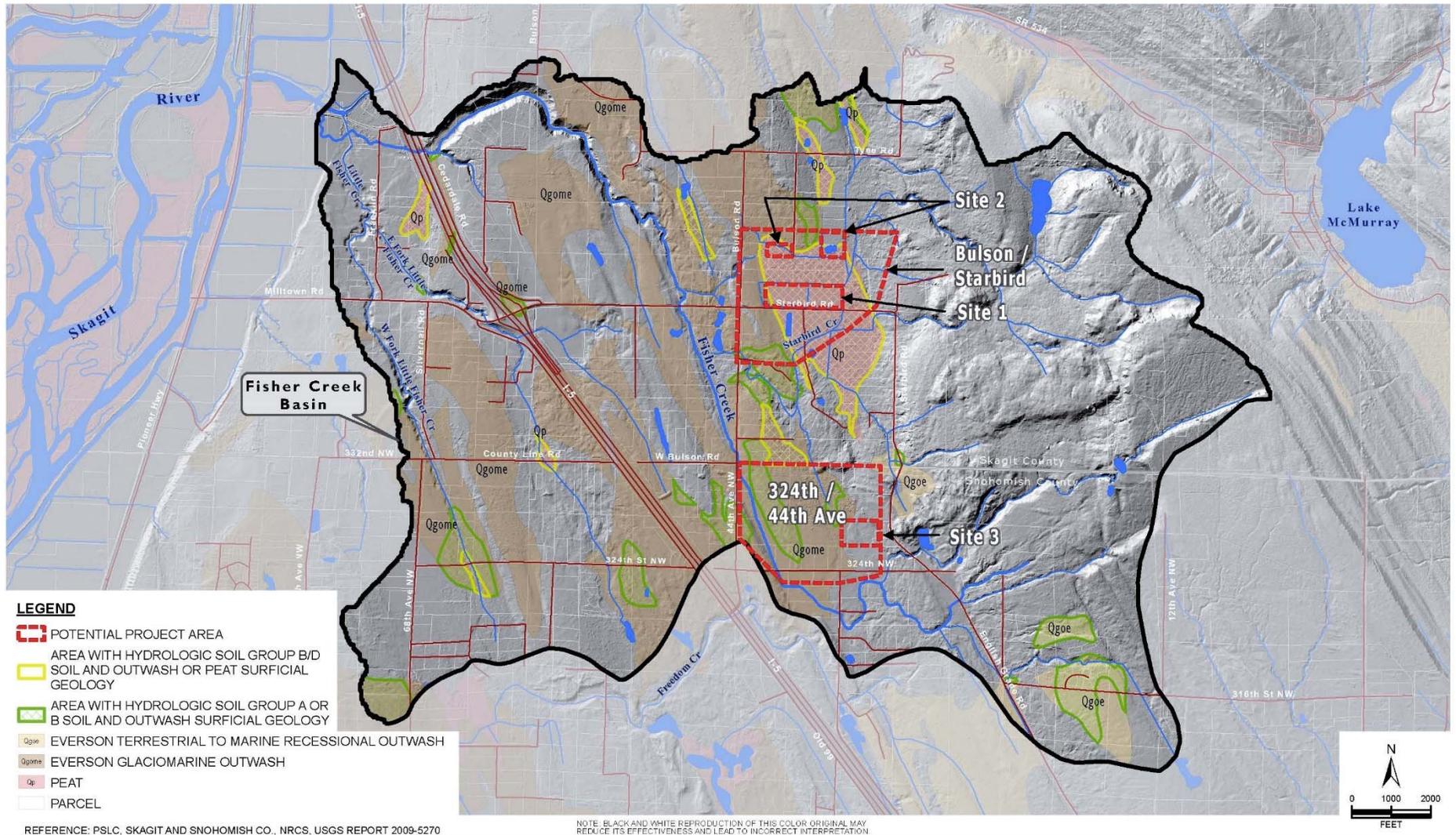
To develop a demonstration project for a ground water mitigation program to mitigate for residential development and enhance streamflow in Fisher Creek Basin

TASK 1: Suitability Assessment

TASK 2: Preliminary Conceptual Design

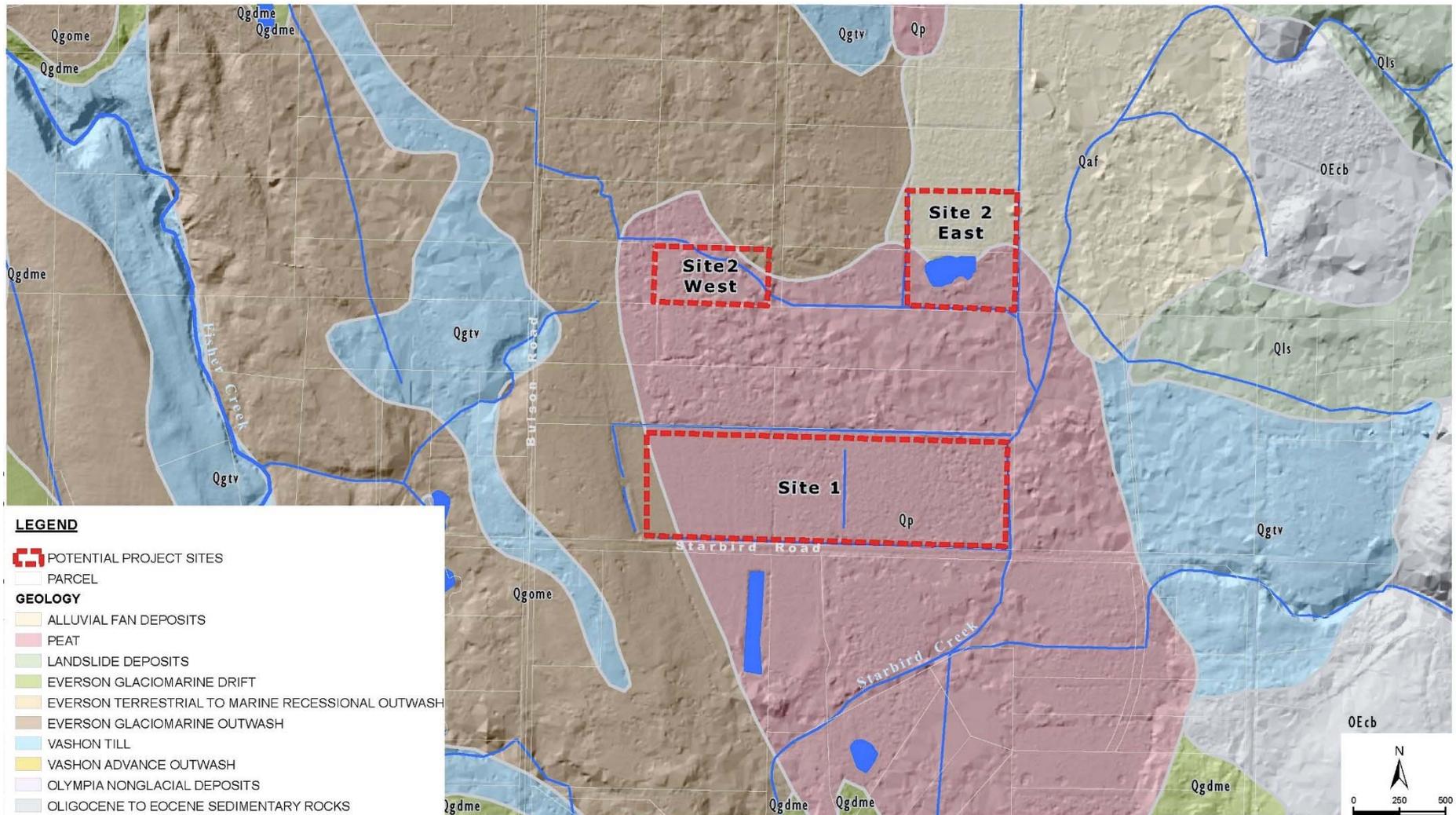
- Site Specific Evaluation
- Preliminary Conceptual Design

POTENTIAL PROJECT AREAS



- Bulson/Starbird Area – Site 1 and Site 2
- 324th / 44th Avenue Area – Site 3

POTENTIAL PROJECT SITES



- **Site 1: Large, flat pasture, Peat soils/geology ~25 acre potential project site**
- **Site 2: Forest, pasture, pond, Peat, alluvial fan deposits, ~2.5 acre project site**

SITE SPECIFIC EVALUATION

FIELD INVESTIGATIONS

- Soil Borings
- Piezometers
- Staff Gages
- Water Level Monitoring
- Geophysics
- Vegetation Survey

ANALYSIS

- Surface Water – Ground Water Interactions
- Existing Site Water Balance

FIELD INVESTIGATIONS

SOIL BORINGS

- Characterize shallow subsurface soil/geologic conditions
- Hand auger samples
- Shelby tube peat samples



FIELD INVESTIGATIONS

PIEZOMETERS

- Ground Water Elevations
- Hydraulic Conductivity Testing



STAFF GAGES

- Surface Water Elevations



FIELD INVESTIGATIONS

WATER LEVEL MONITORING

- Ground water and surface water elevations monitored monthly at ten locations
- Data loggers recording sub-daily water levels at five locations
- Monitoring will continue at least through the low flow season (~ October)



FIELD INVESTIGATIONS

GEOPHYSICAL SURVEY

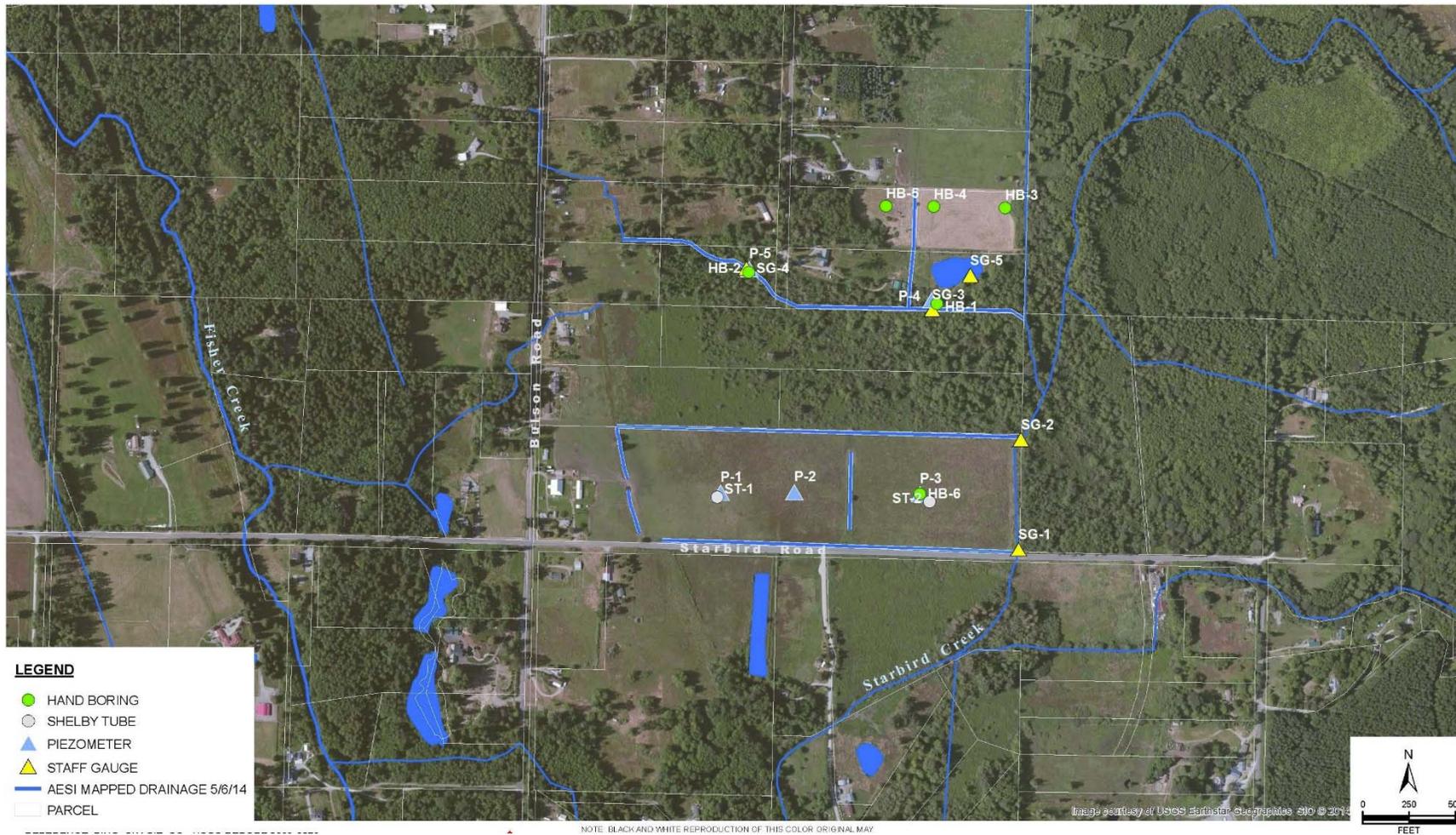
- Thickness of Peat
- Seismic Survey
- Ground Penetrating Radar



VEGETATION SURVEY

- Site 1: Reed canarygrass, common rush, buttercup
- Site 2: Forested/shrub, pasture areas of reed canarygrass

FIELD INVESTIGATIONS



ANALYSIS

GROUND WATER – SURFACE WATER INTERACTIONS

- Ground water movement through peat very slow
 - Water Level Monitoring Data - Very slight hydraulic gradient (slope)
 - Slug Test Data - Low Hydraulic Conductivity
 - Laboratory Testing - Low Effective Porosity
 - Water Level in existing pond on Site 2 ~ 2 feet above ground water
- Ground water discharge to surface water minimal

EXISTING SITE WATER BALANCE

- Inputs – Outputs = Change in Storage
- Monthly for average conditions
- Annual Change in Storage ~0

ANALYSIS

EXISTING SITE WATER BALANCE

- Site 1: 25 acre area
 - Annual Water balance ~99 af/y
- Site 2: 2.5 acre area
 - Annual Water balance ~9.2 af/y

		Water Balance Components (Site 1)	Total (ac-ft)	Total (in)
Input		Precipitation	91.9	44.1
		Surface Runon	7.3	3.5
		Total Input	99.2	47.6
Output		Deep Ground Water Recharge	25.0	12.0
		Ground Water Discharge to Surface Water	0.4	0.2
		Evapotranspiration	42.7	20.5
		Surface Runoff	31.0	14.9
		Total Output	99.1	47.5
		Change in Storage	0.1	0.1

		Water Balance Components (Site 2)	Total (ac-ft)	Total (in)
Input		Precipitation	9.2	44.1
		Surface Runon	0	0
		Total Input	9.2	47.6
Output		Deep Ground Water Recharge	2.5	12.0
		Ground Water Discharge to Surface Water	0.3	1.6
		Evapotranspiration	4.3	20.7
		Surface Runoff	2.5	11.8
		Total Output	8.7	47.5
		Change in Storage	0.4	2

PRELIMINARY CONCEPTUAL DESIGN

CONCEPTUAL DESIGN

- Water Storage / Wetland Rehabilitation
 - Constructed surface water reservoir with wetland features
 - Variable water depths/upland areas
- Discharge
 - To shallow ground water adjacent to stream
 - Mitigation: Skagit River is < instream flow
 - Enhancement: Low flow period in Fisher Creek

Legend

Proposed Habitats

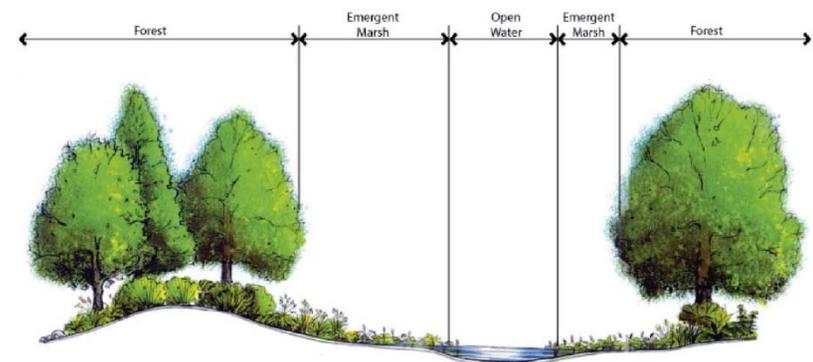
-  Emergent marsh
-  Forest
-  Forest perimeter berm
-  Open water
-  Scrub-shrub



PRELIMINARY CONCEPTUAL DESIGN

WETLAND REHABILITATION FEATURES

- Improves hydrology and water quality
 - Increases storage and retention time
 - Removes cattle grazing activity (Site 1)
- Improve habitat
 - Supports diverse wildlife for invertebrates, amphibians, birds, and mammals
 - Provides habitat structure
- Improve vegetation diversity
 - Supports emergent wetland, scrub/shrub forested wetland areas
 - Helps control invasive reed canarygrass



A. Conceptual Cross-section

PRELIMINARY CONCEPTUAL DESIGN

PROJECT OPERATION FEATURES

- Daily Water Balance / Operation Calculations
 - Based on precipitation 2000-2012
 - Secondary water source would likely be necessary to supplement precipitation/runoff input to project during dry years/periods

Site 1: Example

Foot Print	25	acres
Storage Volume	35.0	acre feet
Days of mitigation	111	average days per year
	38-190	range of days per year
Number of Homes	253	existing + new
Mitigation Volume	15.1	acre feet
Enhancement Volume	7.3	acre feet
Percent Enhancement	35%	

Site 2: Example

Foot Print	2.5	acres
Storage Volume	7.0	acre feet
Days of mitigation	111	average days per year
	38-190	range of days per year
Number of Homes	84	existing + new
Mitigation Volume	5.0	acre feet
Enhancement Volume	1.7	acre feet
Percent Enhancement	27%	

SUMMARY

SUITABILITY ASSESSMENT

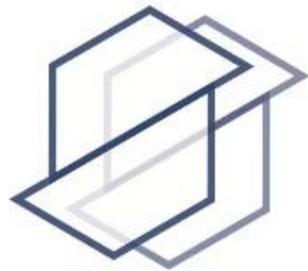
- Identified areas where project might be suitable

SITE SPECIFIC EVALUATION

- Field investigations and analysis on specific parcels
- Analysis suggests ground water flow to surface water may not be viable
- Sites appear to be candidates for wetland rehabilitation given existing soils, hydrology and vegetation

PRELIMINARY CONCEPTUAL DESIGN

- Water Storage / Wetland Rehabilitation
 - Mitigation Water
 - Streamflow Enhancement
 - Wetland Habitat, Hydrologic Function, Water Quality



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Mentor Law Group
PLLC