Seeing Through the Eye of the Storm Using the Lens of Nature

How Nature-based Solutions Enhance Resiliency and Provide Value

Stacey Hellekson, PE
Woodard & Curran

22 September 2022

What Lens Are You Looking Through?

Conventional

Photo by Andy Holmes on Unsplash

Nature-Based

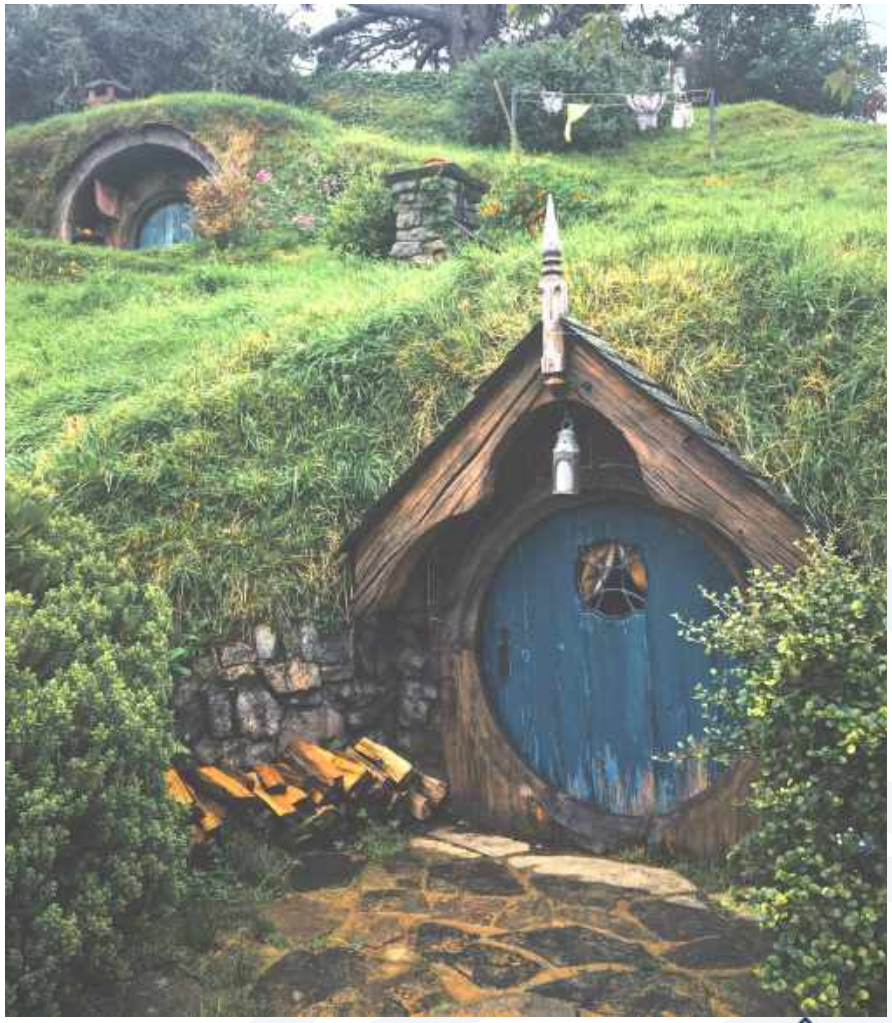

Photo by Jeff Finley on Unsplash

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Agenda

- **What Does a Conventional Approach Look Like When It Fails?**
- **How Do You Assess Climate to be Proactive?**
- **What Does a Nature-based Plan Look Like?**

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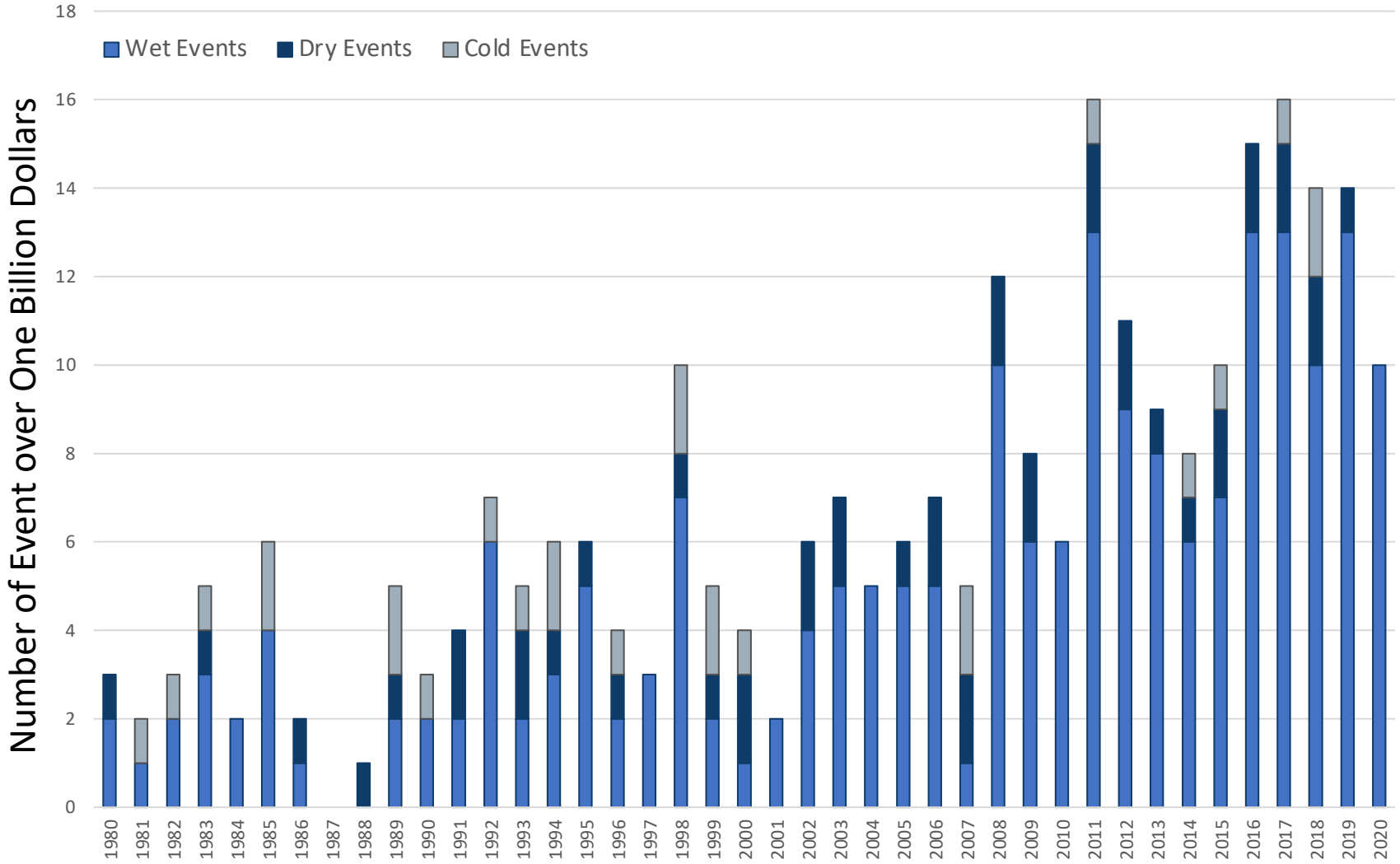
Frequency and Cost of Disasters Continue to Rise



https://www.ncdc.noaa.gov/billions/time-series/US

What Does a Conventional Approach Look Like When It Fails?

Superfund Site infrastructure impacted with extreme weather events

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Impacts to the Site

Ground Water Treatment
Pumping & Conveyance

Stormwater Management
Water Supply

Power
Security & Access

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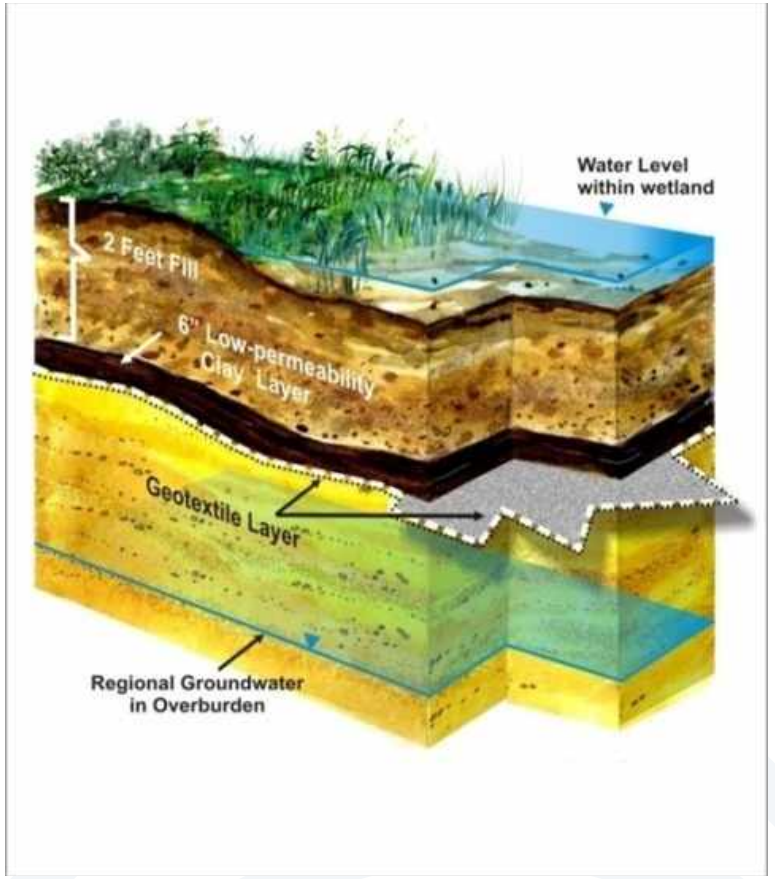
Extensive Rebuild with Resilience

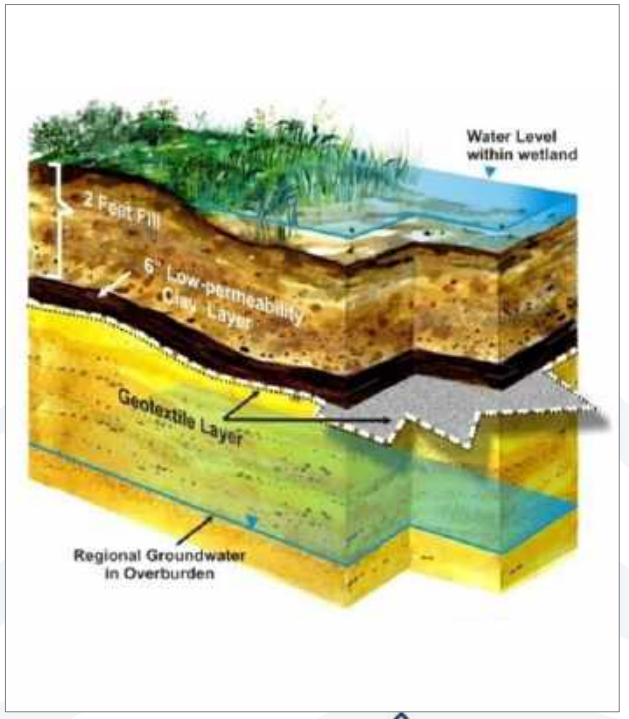


Building Resilience into Beneficial Reuse

Create wetlands and upland meadow habitat

Provide for active/passive recreation

Partial diversion of stream to reduce flow into downstream river during flood events



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How Do You Assess Climate to be Proactive?

Incorporating Climate Science, Business Strategy, and Resilience Engineering for a Proactive Solution

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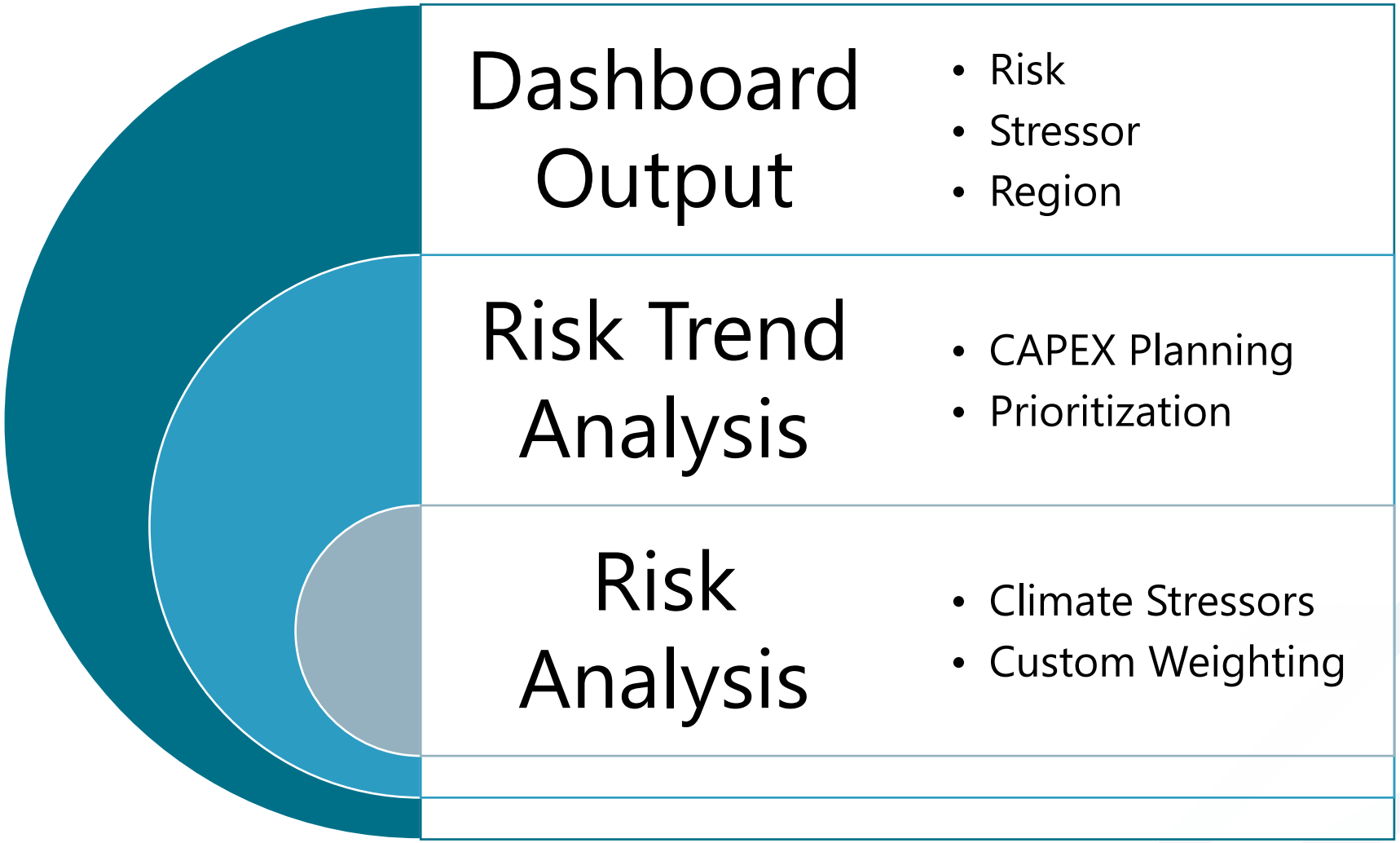
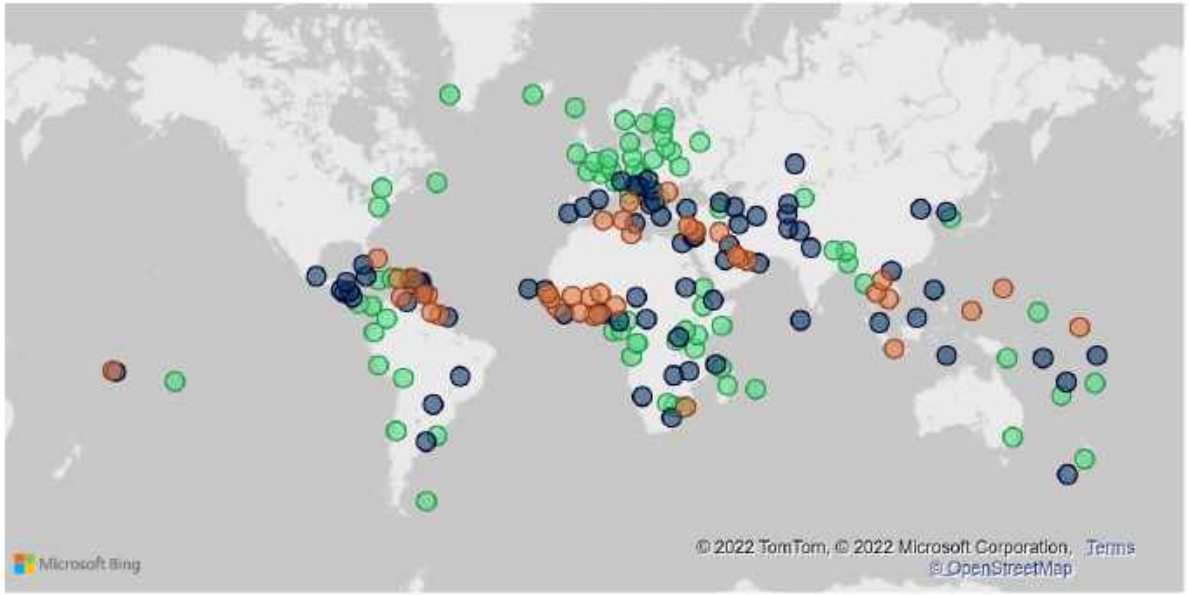
Analysis and Access of Global Portfolio Risk Data



Global Portfolio Climate Change Risk Assessment - Relative Risk Data Interface

Company: Acme Corp. | Project: 0123456.00 | Version: 2022-05-11

Figure 1 - Site Locations and Relative Climate Risk Category (hover over site for details)

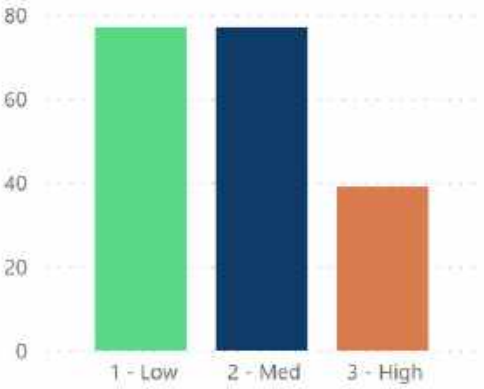


Relative Climate Risk Cat. 1 - Low 2 - Med 3 - High

Data Table 1 - Relative Climate Risk Ranking and Analysis

name	Total Relative Risk Score	Risk Cat.	1st Max	2nd Max	D	F	H	P	W	C	R
Georgetown	4.94	3 - High	C	W	0.95	0.81	0.84	0.37	0.97	0.99	0.00
Bamako	4.65	3 - High	F	W	0.87	0.98	0.95	0.87	0.98	0.00	0.00
Bangkok	4.21	3 - High	R	H	0.13	0.88	0.93	0.78	0.51	0.00	0.99
Bissau	4.14	3 - High	W	H	0.72	0.85	0.86	0.79	0.92	0.00	0.00
Accra	4.05	3 - High	F	H	0.40	0.99	0.97	0.89	0.80	0.00	0.00
Ouagadougou	3.92	3 - High	H	P	0.48	0.75	0.96	0.86	0.86	0.00	0.00
Road Town	3.89	3 - High	C	D	0.87	0.18	0.67	0.40	0.78	0.99	0.00
Banjul	3.84	3 - High	W	D	0.84	0.83	0.77	0.50	0.90	0.00	0.00
Lome	3.83	3 - High	C	H	0.34	0.02	0.95	0.85	0.66	1.00	0.00
Phnom Penh	3.81	3 - High	H	F	0.24	0.94	0.99	0.81	0.84	0.00	0.00
Niamey	3.72	3 - High	F	H	0.53	0.95	0.86	0.67	0.71	0.00	0.00
Vientiane	3.71	3 - High	R	H	0.25	0.32	0.90	0.82	0.43	0.00	1.00

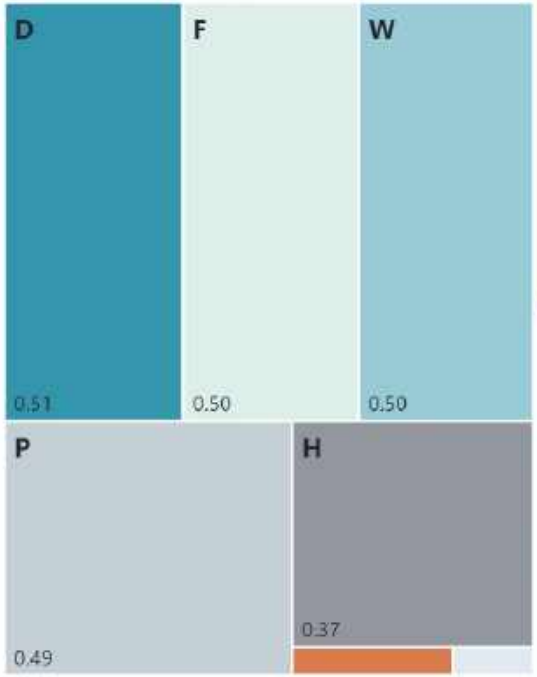
Figure 2 - Relative Climate Change Risk Category Breakdown of Sites



2.41
Avg. Total Relative Risk Score of Sites

193
# of Sites Selected

Figure 3 - Climate Change Stressor Contribution of Sites



Climate Risk Data Filters

Climate Period
- (●) 2020-2039
- ( ) 2040-2059
- ( ) 2060-2079
- ( ) 2080-2099

Relative Climate Risk Category
- [ ] 1 - Low
- [ ] 2 - Med
- [ ] 3 - High

Max Stressor
- [ ] C
- [ ] D
- [ ] F
- [ ] H
- [ ] P
- [ ] R
- [ ] W

2nd Max Stressor
- [ ] D
- [ ] F
- [ ] H
- [ ] P
- [ ] W

Climate Change Stressor Legend

D = Drought
F = Flooding Potential
H = Extreme Heat
P = Extreme Seasonal Precipitation
W = Wildfire Conditions
C = Coastal Inundation
R = Riverine Inundation

Company Data Filters

SBU: All

Facility Type: All

Region: All

Country: All

Facility Name
Search
[ ] Select all

Reset All Filters to Default

Contact Information: msjones@woodardcurran.com

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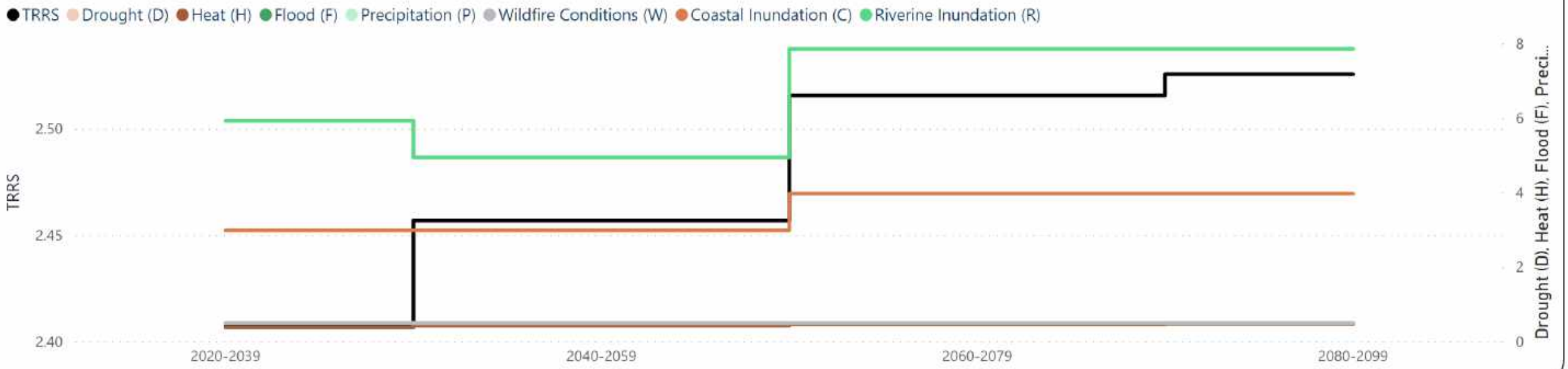
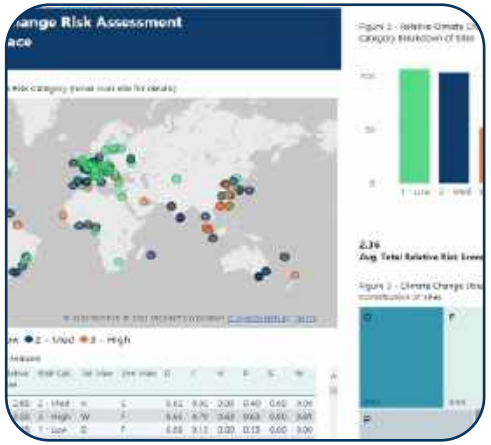
Average Total Relative Risk Score and Stressor Percent Ranks of Sites by Climate Period



Summary of Total Relative Risk Scores and Stressor Percent Ranks

Timeframe	2020-2039									2040-2059									2060-2079									2080-2099						
name	D	F	H	P	W	C	R	TRRS	LMH	D	F	H	P	W	C	R	TRRS	LMH	D	F	H	P	W	C	R	TRRS	LMH	D	F	H	P	W	C	R
Abu Dhabi	0.84	0.57	0.78	0.26	0.84	0.00	0.00	3.29	3 - High	0.78	0.48	0.63	0.28	0.64	0.00	0.00	2.80	2 - Med	0.52	0.55	0.48	0.25	0.34	0.00	0.00	2.14	1 - Low	0.54	0.59	0.47	0.31	0.38	0.00	0.0
Abuja	0.53	0.65	0.78	0.91	0.46	0.00	0.00	3.33	3 - High	0.41	0.97	0.77	0.88	0.44	0.00	0.00	3.47	3 - High	0.33	0.35	0.75	0.89	0.46	0.00	0.00	2.78	2 - Med	0.31	0.70	0.80	0.85	0.55	0.00	0.0
Accra	0.40	0.99	0.97	0.89	0.80	0.00	0.00	4.05	3 - High	0.39	0.80	0.95	0.82	0.87	0.00	0.00	3.82	3 - High	0.40	0.96	0.95	0.80	0.88	0.00	0.00	3.99	3 - High	0.41	0.73	0.95	0.17	0.88	0.00	0.0
Addis Ababa	0.21	0.45	0.00	0.50	0.11	0.00	0.00	1.27	1 - Low	0.38	0.81	0.00	0.71	0.20	0.00	0.00	2.10	1 - Low	0.33	0.77	0.01	0.75	0.16	0.00	0.00	2.02	1 - Low	0.26	0.63	0.02	0.79	0.11	0.00	0.0
Algiers	0.97	0.78	0.71	0.17	0.93	0.00	0.00	3.57	3 - High	0.97	0.43	0.63	0.37	0.90	0.00	0.00	3.29	3 - High	0.95	0.25	0.58	0.29	0.81	0.00	0.96	3.84	3 - High	0.93	0.22	0.53	0.25	0.72	0.00	0.9
Amman	1.00	0.27	0.58	0.20	0.96	0.00	0.00	3.02	2 - Med	1.00	0.26	0.54	0.28	0.95	0.00	0.00	3.04	2 - Med	0.99	0.13	0.51	0.19	0.86	0.00	0.00	2.69	2 - Med	1.00	0.17	0.51	0.27	0.79	0.00	0.0
Amsterdam	0.37	0.34	0.00	0.67	0.40	0.00	0.00	1.77	1 - Low	0.36	0.51	0.00	0.62	0.31	0.00	0.00	1.80	1 - Low	0.42	0.39	0.01	0.63	0.21	0.00	0.00	1.66	1 - Low	0.45	0.35	0.24	0.69	0.19	0.00	0.0
Andorra la Vella	0.84	0.51	0.00	0.62	0.73	0.00	0.00	2.71	2 - Med	0.87	0.53	0.00	0.23	0.67	0.00	0.00	2.30	2 - Med	0.97	0.42	0.30	0.33	0.78	0.00	0.00	2.81	2 - Med	0.93	0.31	0.33	0.44	0.67	0.00	0.0
Ankara	0.84	0.60	0.00	0.33	0.73	0.00	0.00	2.51	2 - Med	0.85	0.29	0.00	0.65	0.65	0.00	0.00	2.43	2 - Med	0.86	0.47	0.01	0.49	0.66	0.00	0.00	2.47	2 - Med	0.90	0.37	0.02	0.47	0.64	0.00	0.0
Antananarivo	0.55	0.11	0.00	0.74	0.38	0.00	0.00	1.78	1 - Low	0.60	0.77	0.00	0.48	0.43	0.00	0.00	2.28	2 - Med	0.54	0.85	0.01	0.43	0.32	0.00	0.00	2.14	1 - Low	0.51	0.62	0.02	0.45	0.28	0.00	0.0
Apia	0.19	0.24	0.98	0.98	0.85	0.00	0.00	3.24	3 - High	0.21	0.78	0.96	0.48	0.99	0.00	0.00	3.43	3 - High	0.18	0.71	0.92	0.40	0.92	0.00	0.00	3.13	3 - High	0.24	0.35	0.93	0.02	0.97	0.00	0.0
Ashgabat	0.93	0.39	0.56	0.20	0.87	0.00	0.00	2.95	2 - Med	0.94	0.24	0.55	0.35	0.78	0.00	0.00	2.86	2 - Med	0.93	0.34	0.50	0.25	0.75	0.00	0.00	2.77	2 - Med	0.90	0.17	0.49	0.34	0.68	0.00	0.0
Asmara	0.40	0.12	0.00	0.24	0.24	0.00	0.00	1.00	1 - Low	0.51	0.55	0.00	0.26	0.33	0.00	0.00	1.65	1 - Low	0.56	0.23	0.01	0.31	0.35	0.00	0.00	1.45	1 - Low	0.52	0.65	0.27	0.38	0.32	0.00	0.0

Prioritize Resiliency Plan through Refined Climate Risk Assessments



Global Level

Community Level

Site Level

Asset Level

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What Does a Nature-based Plan Look Like?

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Remedy Drivers

Historic Mining

Stormwater Treatment

Sediment Capture

Public Engagement

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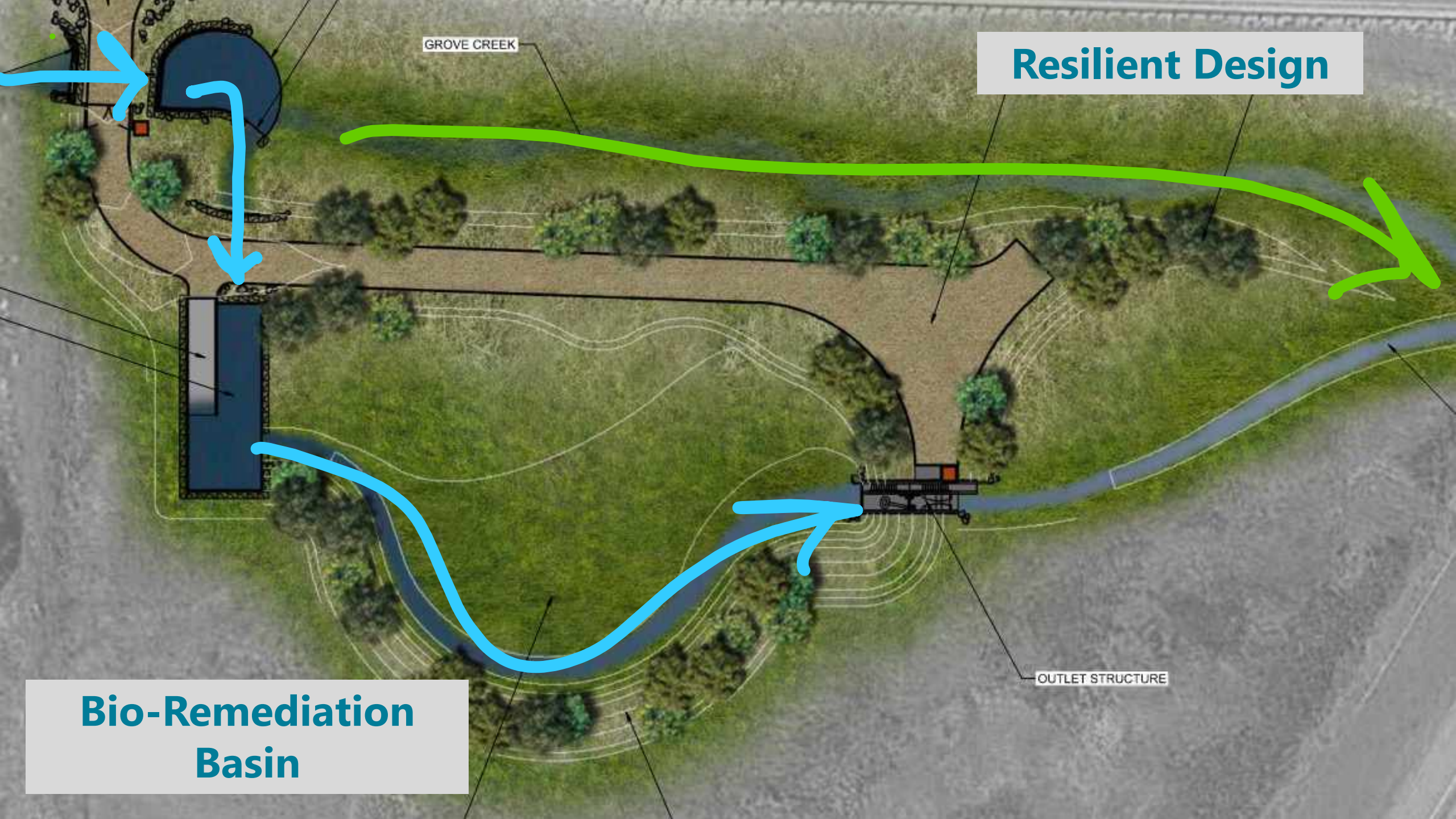
Conventional Design

Concrete Channel

- ESG Goals Misaligned
- Not in Public Interest
- Long-term Solution


GROVE CREEK
Resilient Design
OUTLET STRUCTURE
Bio-Remediation Basin

Resilient Design Details

- Treatment flow design for 6-month RI
- Maximum orifice flow 20 cfs
- Allows for maximum sediment removal
- Weir overflow accommodate larger storms

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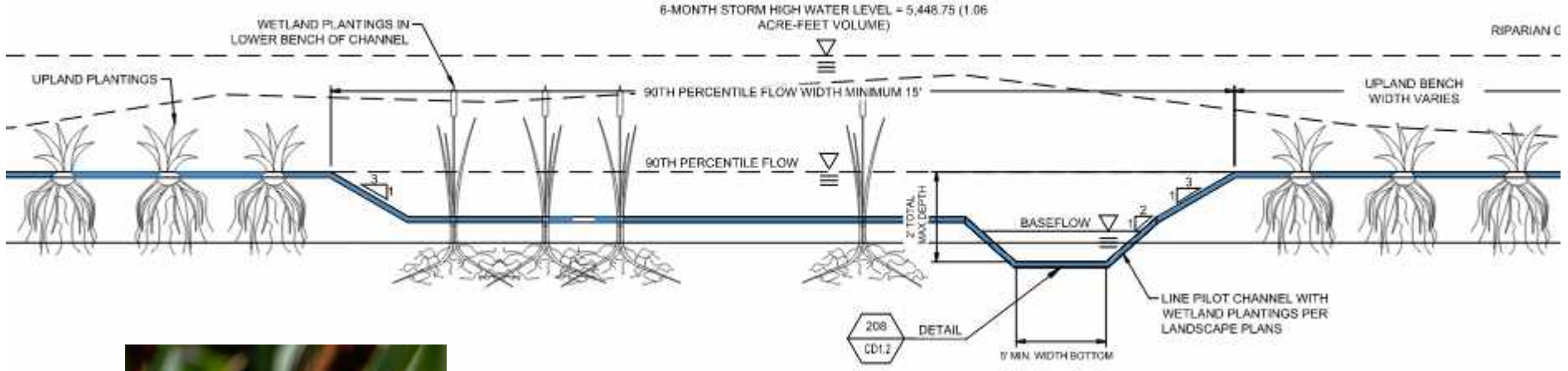
Plant Selection for Phyto-remediation

Fuzzy Tongue Penstemon
(Zn)



Yarrow
(Cd)

Cattail
(As)

Showy Milkweed

Marsh marigold

Horn tail

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Looking through the nature-based lens

	Nature-based	Conventional
CAPEX		
Flexible Storm Design		
Community aesthetic value		
Enhance Biodiversity		
Recharge local groundwater		
Retention time		
OPEX		
End of Life		
Carbon Footprint		

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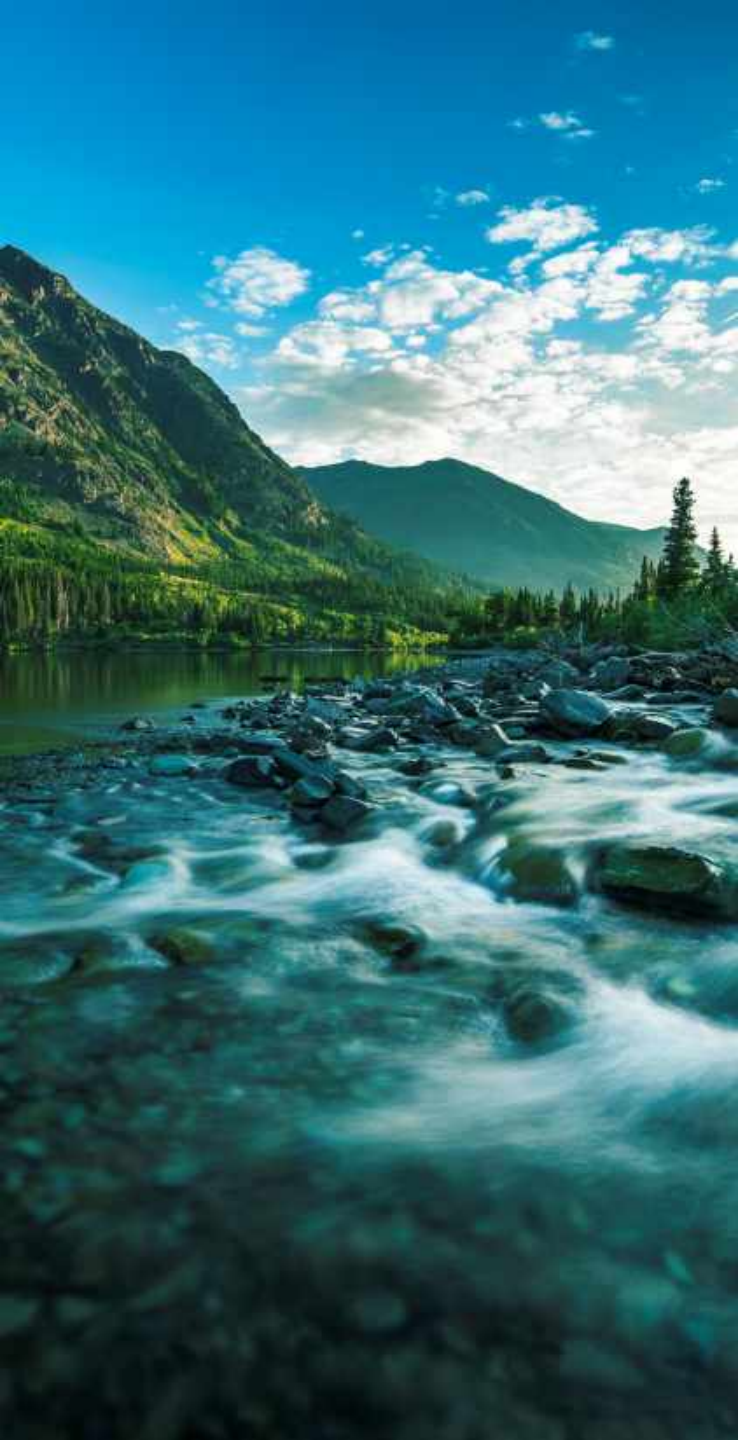

Nature-based Solutions Feel Good!

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