Sustainable runoff management using spatial modeling and multi-objective optimization

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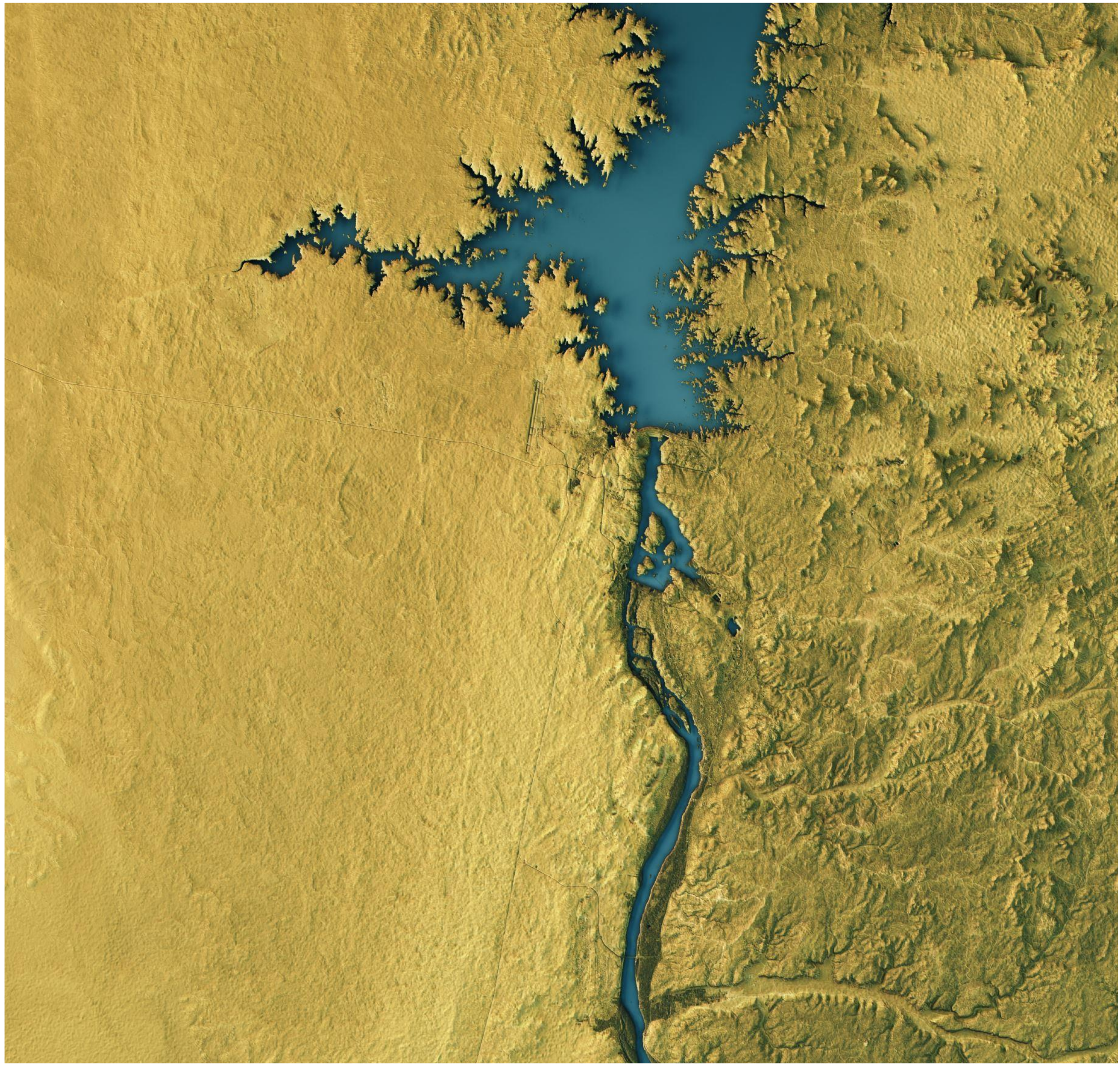

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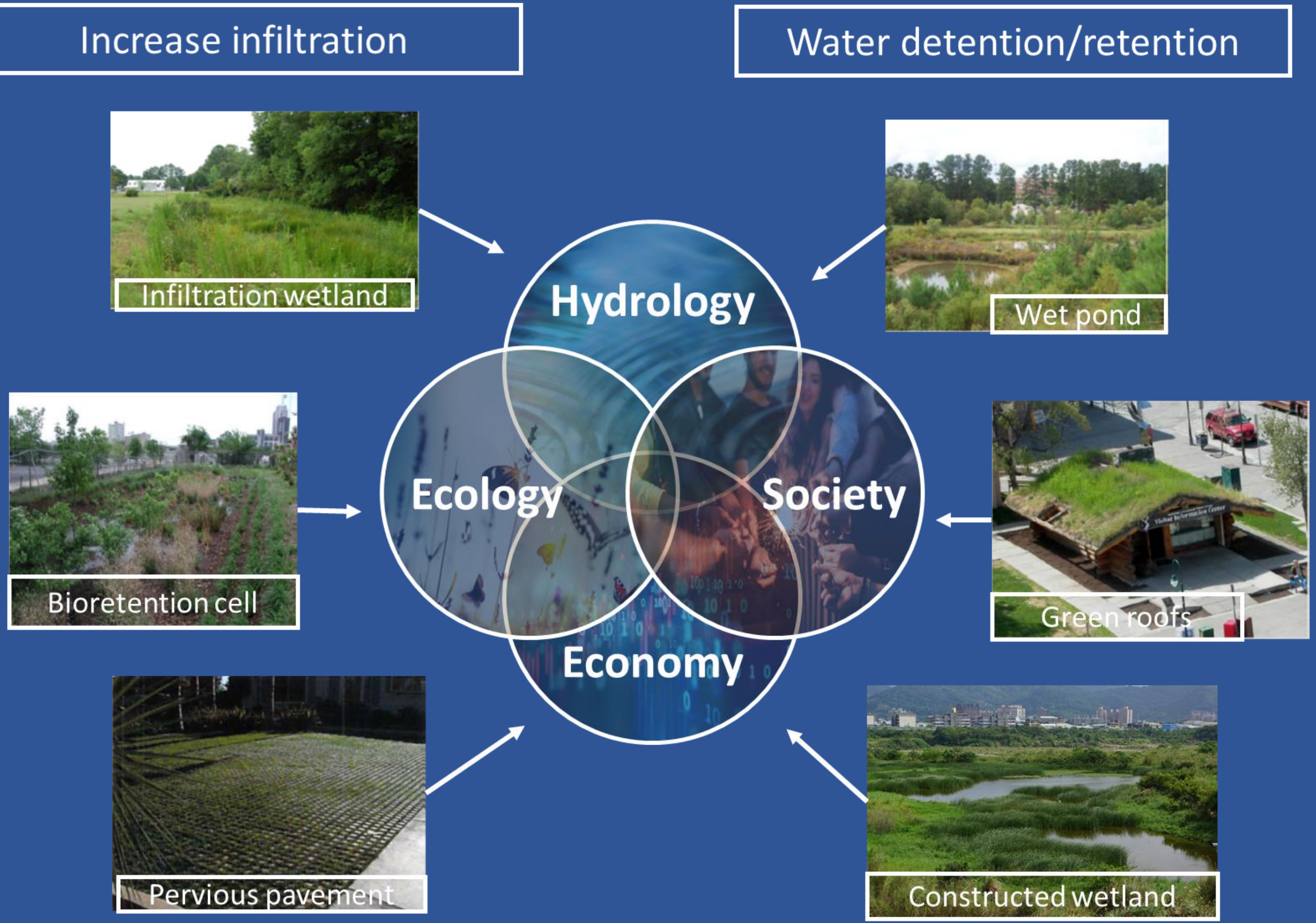
Water Sensitive Planning (WSP)- reducing the negative impacts of stormwater and treating runoff as a valuable resource



Increase infiltration

Water detention/retention

Infiltration wetland

Bioretention cell

Pervious pavement

Wet pond

Green roofs

Constructed wetland

Objective and Methodology

Spatial modelling tool

✚

Multi-objective optimization

→

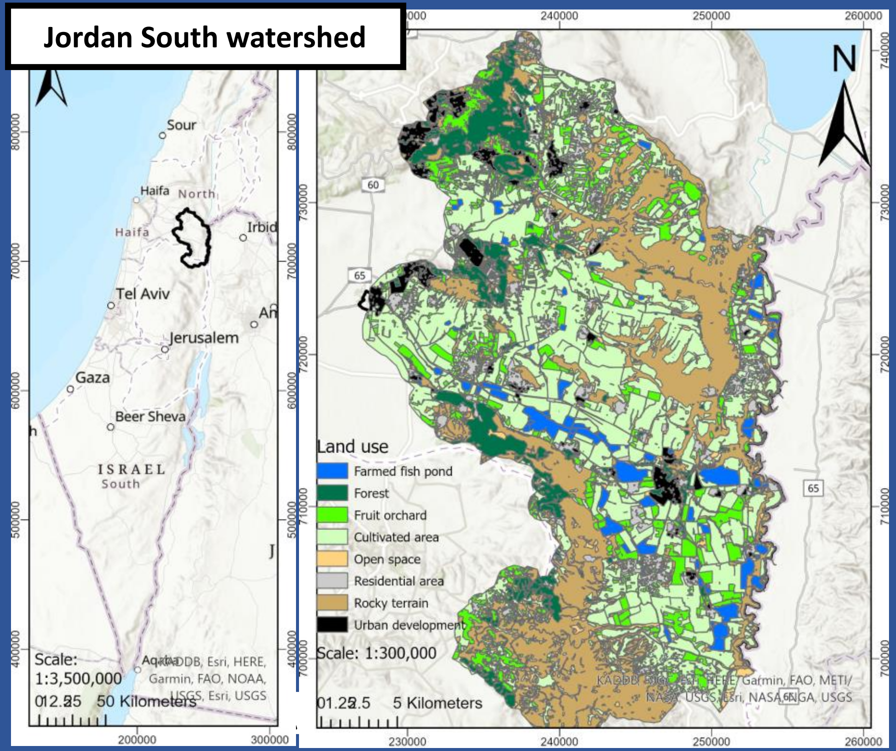
Optimal placement of WSP solutions

Pareto

$$f_{1,opt} = min f_1(x)$$
$$f_{2,opt} = min f_2(x)$$
$$\vdots$$
$$f_{n,opt} = max f_n(x)$$

Transformation-based methods

$$F(X) = w_1 f_1(x) + w_2 f_2(x) + \ldots + w_n f_n(x)$$



Strategy 1: OpenNSPECT + Pareto

Stage 1:

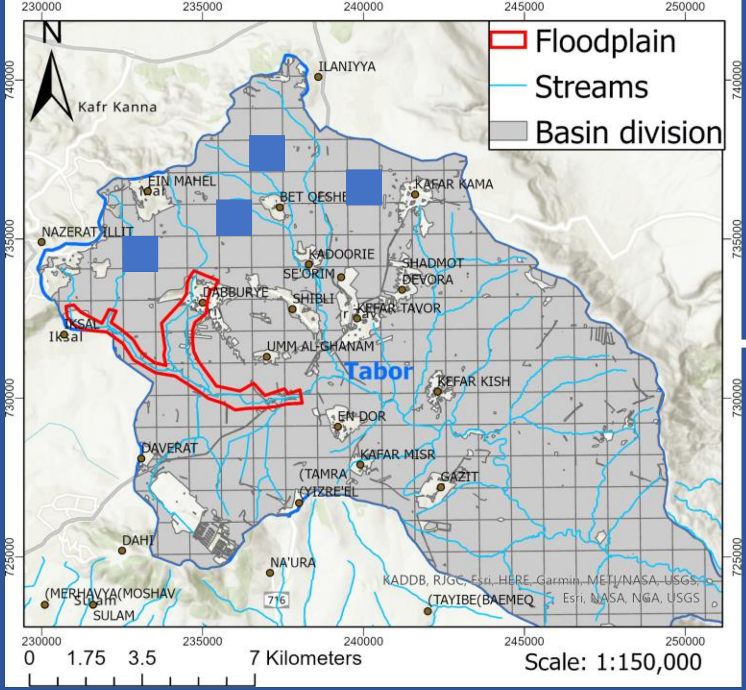
Baseline scenario of the watershed (OpenNSPECT)

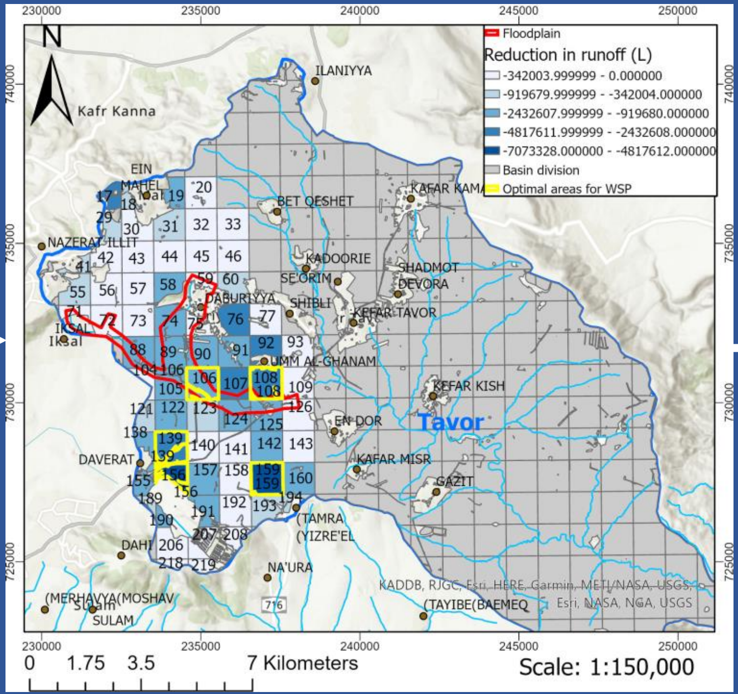
Stage 2:

Sensitivity analysis (OpenNSPECT)

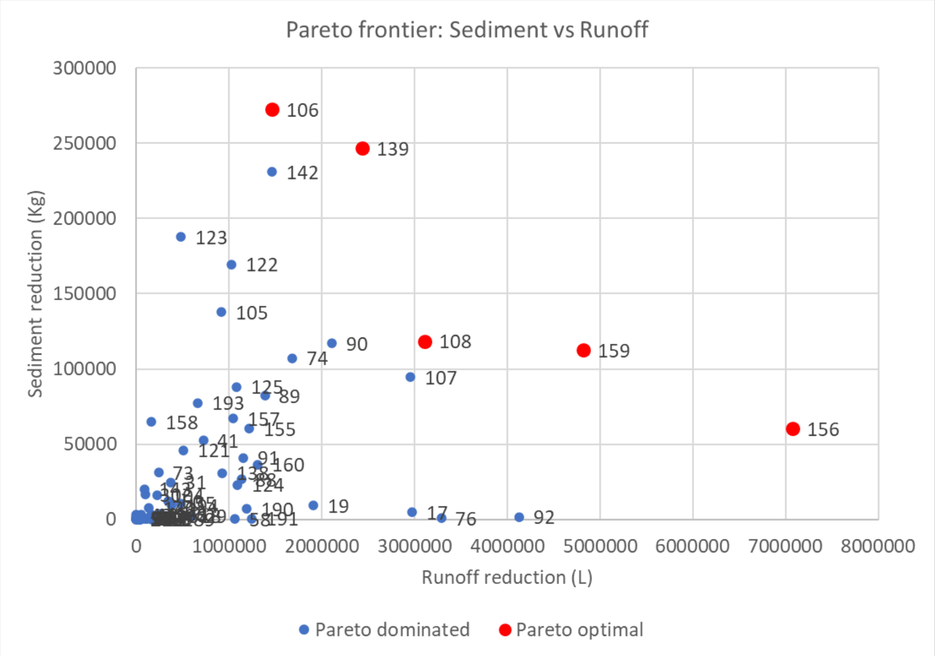
Stage 3:

Pareto frontier





Numbers correspond to land parcels



OpenNSPECT

An Open-Source Version of the Nonpoint Source Pollution and Erosion Comparison Tool

Strategy 2: SWAT + MARXAN

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Stage 1:

Baseline scenario of the watershed

(SWAT)

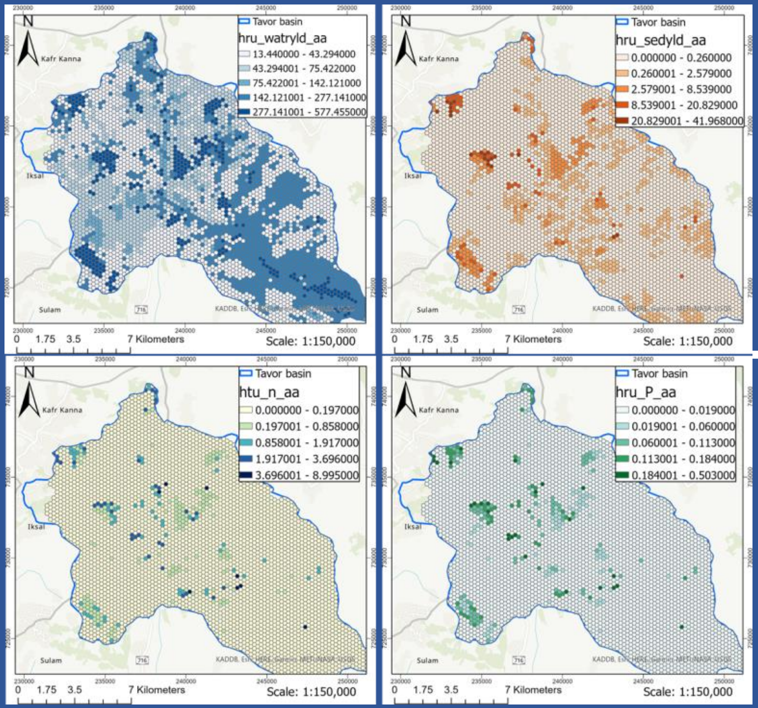
Stage 2:

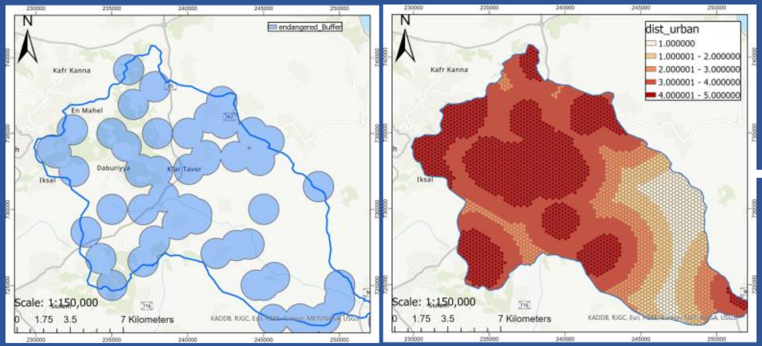
creating abundance layers of different features

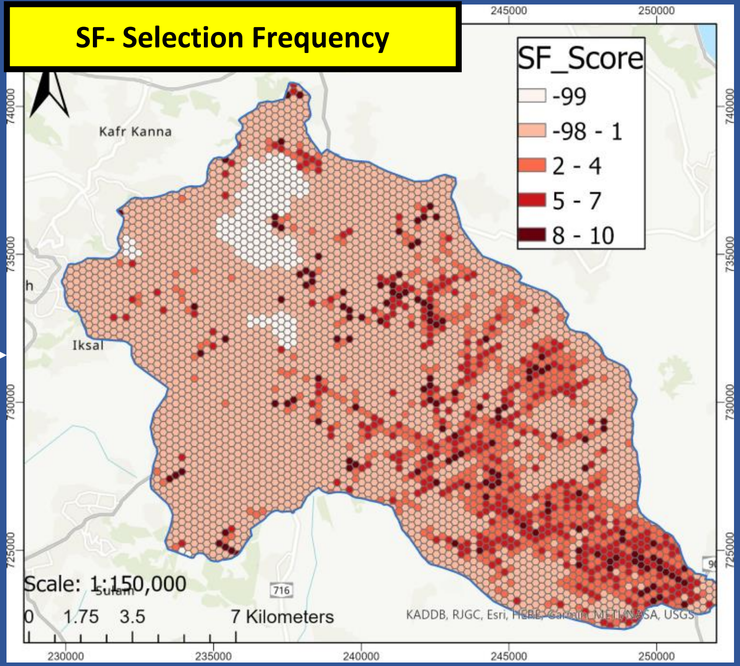
(SWAT+MARXAN)

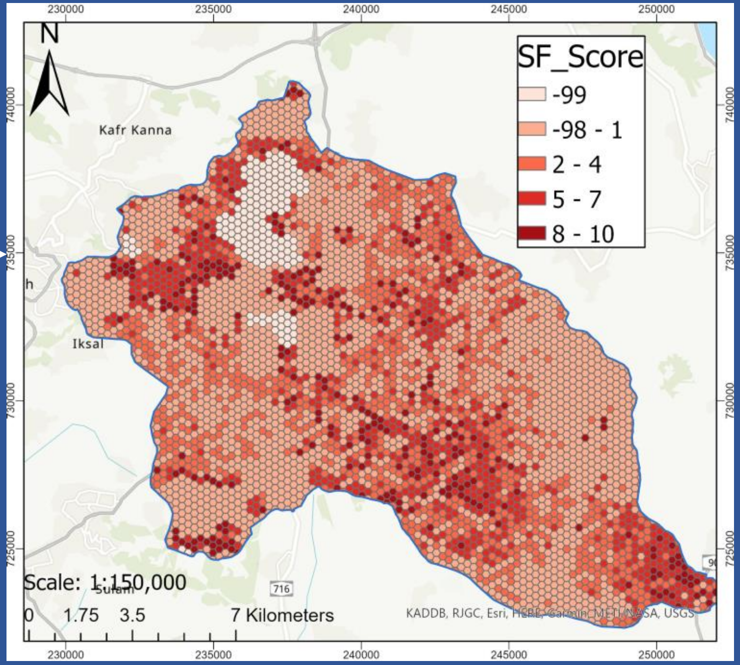
Stage 3:

Areas of highest abundance at minimum cost (MARXAN)









$$\min Total\ cost = \underbrace{\sum_{PUs} Cost}_{1} + \underbrace{BLM \sum_{PUs} Boundary}_{2} + \underbrace{\sum_{Target\ Value} SPF \times Penalty}_{3}$$

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Summary and Implications

- Consider ecological, and social goals along with hydrological goals.
- Mitigate the knowledge gap about the potential benefits of runoff.
- Help planners and stakeholders with optimal runoff management strategy.

Thank you!

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