Austin Integrated Water Resource Planning Community Task Force

Packet Index

April 18, 2017

Austin Integrated Water Resource Planning Community Task Force
April 18, 2017 – 4:00 p.m.
Waller Creek Center, Room 104
625 East 10th Street
Austin, Texas 78701

For more information go to:
Austin Integrated Water Resource Planning Community Task Force

AGENDA

Voting Members:

Sharlene Leurig - Chair	Marianne Dwight	Sarah Richards
Jennifer Walker – Vice Chair	Diane Kennedy	Lauren Ross
Todd Bartee	Perry Lorenz	Robert Mace
Clint Dawson	Bill Moriarty	

Ex Officio Non-Voting Members:
Austin Water: Greg Meszaros
Austin Energy: Kathleen Garrett
Austin Resource Recovery: Sam Angoori
Neighborhood Housing and Community Development: Rebecca Giello
Office of Innovation: Kerry O'Connor
Office of Sustainability: Lucia Athens
Parks and Recreation: Sara Hensley
Watershed Protection: Mike Personett

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1. CALL TO ORDER – April 18, 2017, 4:00 p.m.

2. CITIZEN COMMUNICATION

The first 10 speakers signed up prior to the meeting being called to order will each be allowed a three-minute allotment to address their concerns regarding items not posted on the agenda.

3. APPROVAL OF MEETING MINUTES

a. Approval of the meeting minutes from the April 11, 2017 Task Force meeting (5 minutes)

4. STAFF BRIEFINGS, PRESENTATIONS, AND OR REPORTS

a. Presentation of draft weightings for the integrated water resource planning objectives and sub-objectives – City Staff (15 minutes)
   i. Task Force Discussion and Input
b. Progress update on geospatial analysis of decentralized options (including rainwater, stormwater, graywater, onsite blackwater reuse, and wastewater scalping or sewer mining) – Consultant team (joining remotely from Australia) (90 minutes)
   i. Task Force Discussion and Input

5. SUBCOMMITTEE REPORTS

6. VOTING ITEMS FROM TASK FORCE

7. FUTURE AGENDA ITEMS

8. ADJOURN

Note: Agenda item sequence and time durations noted above are subject to change.

The City of Austin is committed to compliance with the American with Disabilities Act. Reasonable modifications and equal access to communications will be provided upon request. Meeting locations are planned with wheelchair access. If requiring Sign Language Interpreters or alternative formats, please give notice at least 2 days (48 hours) before the meeting date. Please call Austin Integrated Water Resource Planning Community Task Force, at 512-972-0194, for additional information; TTY users route through Relay Texas at 711.

For more information on the Austin Integrated Water Resource Planning Community Task Force, please contact Marisa Flores Gonzalez at 512-972-0194.

MINUTES

The *Austin Integrated Water Resource Planning Community Task Force* convened in a regular meeting on April 11, 2017 at Waller Creek Center, Conference Rm 104, 625 E 10th Street, in Austin, Texas.

Members in Attendance:

Sharlene Leurig - Chair
Jennifer Walker – Vice Chair
Todd Bartee
Clint Dawson
Diane Kennedy
Perry Lorenz
Robert Mace
Sarah Richards
Lauren Ross

Ex-Officio Members in Attendance:
Greg Mezaros, Mike Personett, Lucia Athens

Staff in Attendance:
Kevin Critendon, Teresa Lutes, Joe Smith, Marisa Flores Gonzalez, Mark Jordan, Ginny Guerrero, Prachi Patel, Shannon Halley, Katherine Jashinski, Ryan Robinson

Additional Attendees:

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1. CALL TO ORDER
Sharlene Leurig, Chair, called the meeting to order at 6:10 p.m.

2. CITIZEN COMMUNICATION: GENERAL
None

3. APPROVAL OF MEETING MINUTES
The meeting minutes from the March 7, 2017 Austin Integrated Water Resource Planning Community Task Force regular meeting were approved on Member Ross's motion and Member Kennedy's second on a 8-0-1-2 vote with Member Richards abstaining and Members Moriarty and Dwight absent.

4. STAFF BRIEFINGS, PRESENTATIONS, AND/OR REPORTS

a. Demographic Follow-Up Presentation was provided by Ryan Robinson, City Demographer, Planning and Zoning Department. This briefing was followed by a Task Force discussion including questions and answers.
b. Near Term Schedule and Process update was provided by Marisa Flores Gonzalez, Senior Planner, Austin Water. This briefing was followed by a Task Force discussion including questions and answers.
c. Public Outreach Update was provided by Ginny Guerrero, Community Engagement Specialist, Austin Water. This briefing was followed by a Task Force discussion including questions and answers.
d. Water Supply Options Update was provided by Teresa Lutes, P.E., Managing Engineer, Austin Water. This briefing was followed by a Task Force discussion including questions and answers.

5. SUBCOMMITTEE REPORTS
None

6. VOTING ITEMS FROM TASK FORCE
None

10. FUTURE AGENDA ITEMS

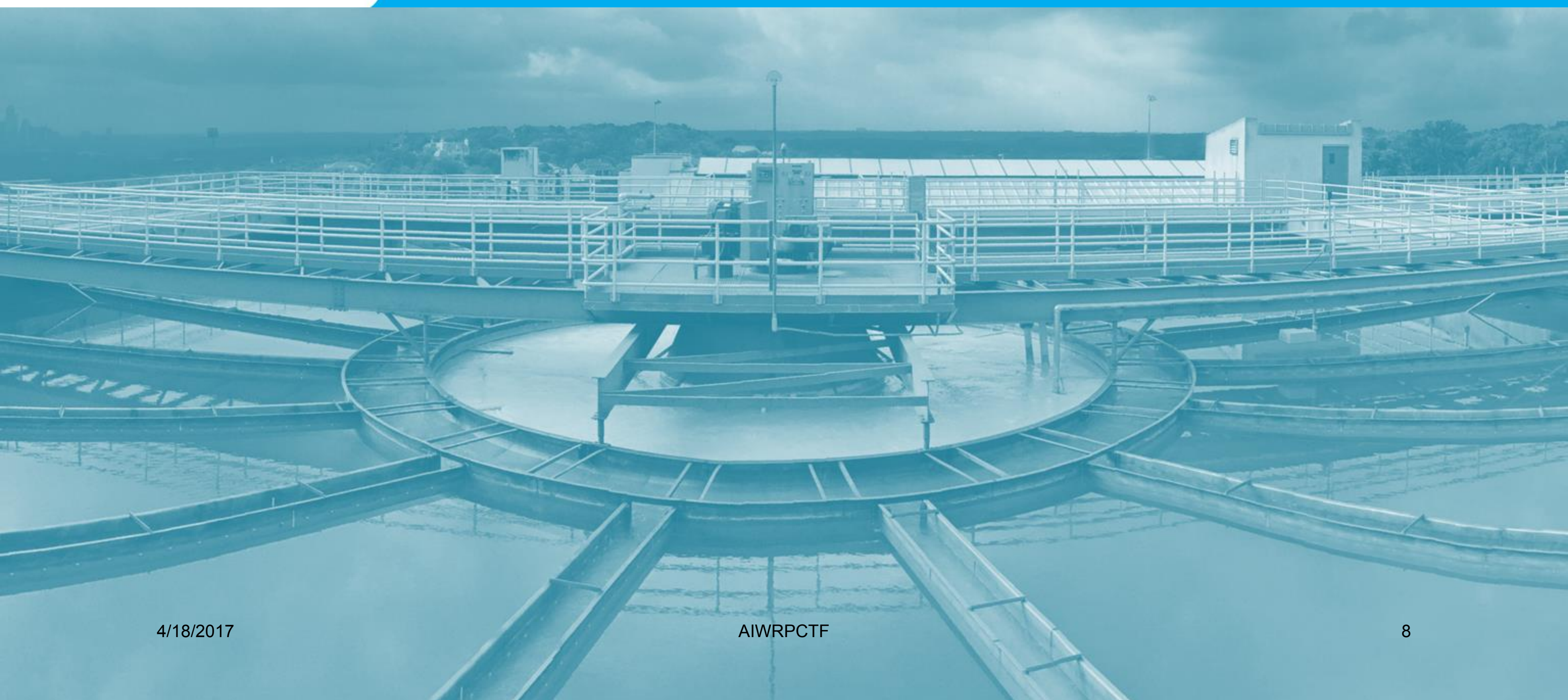
None

Chair Leurig adjourned the meeting at 7:53 pm.

PRESENTATION

Water Forward
Austin's Integrated Water Resources Plan
Task Force Meeting

April 18, 2017



Draft Weightings For Objectives And Subobjectives

Portfolio Scoring and Ranking Process

Figure from p. 12 of Task 2 Technical Memorandum

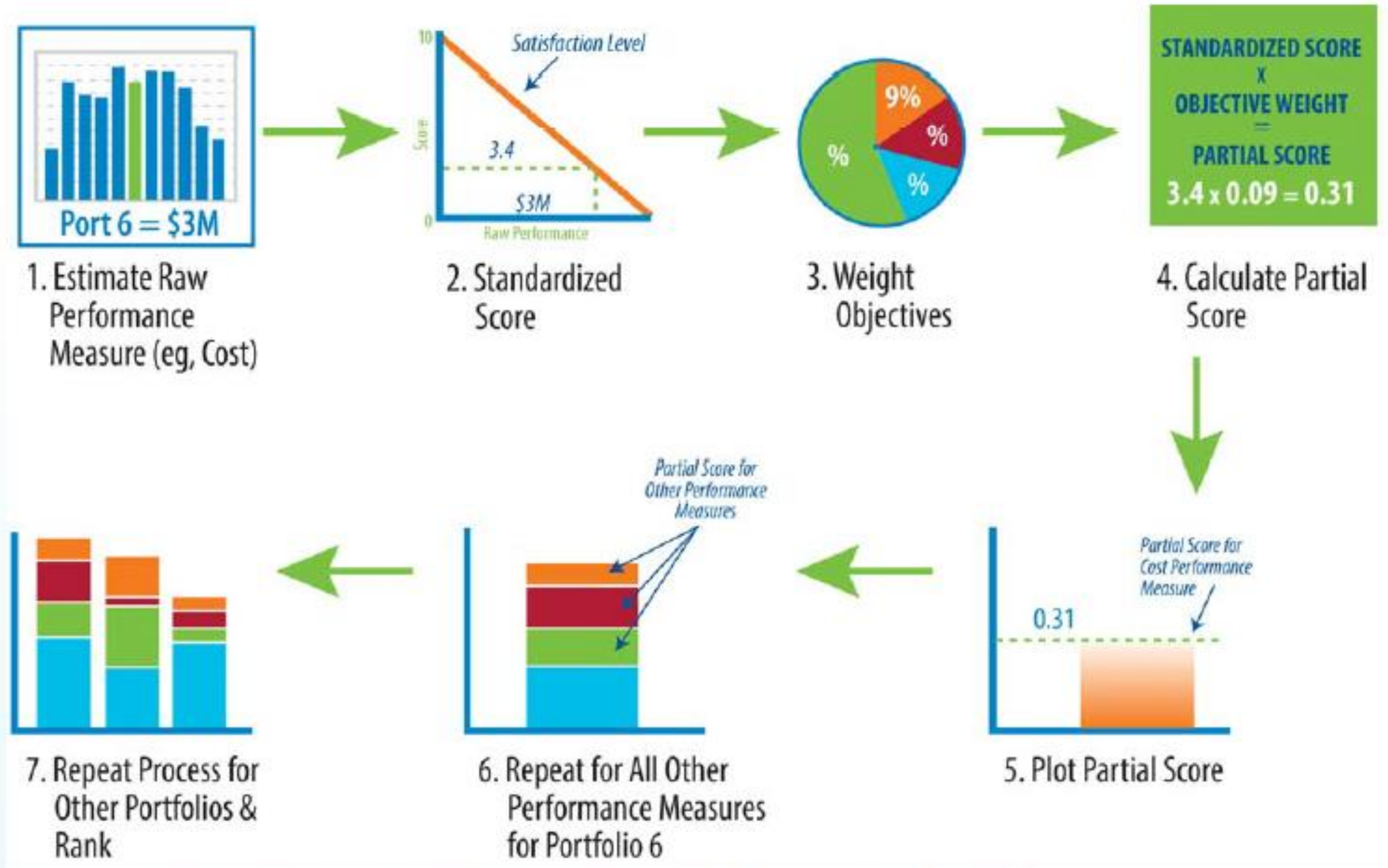


Figure 3 – Multi-Attribute Rating Technique Used by CDP Software to Rank Portfolios

Draft Water Forward Objectives and Subobjectives Weighting

Primary Objective	Objective Weight	Sub-Objective	Sub-Objective Weight	Defining Question	Performance Measure	Overall Weight
Water Supply Benefits	30%	Maximize Water Reliability	50%	How does the portfolio perform in terms of reliability (how often is there shortage), vulnerability (how large is the shortage), recovery (how fast is the recovery from shortages) under various hydrologic conditions, including climate change scenarios?	Water Supply Index (0 to 1) based on WAM modeling results	15%
		Maximize Local Control	25%	To what extent does AW have control over the quantity and storage of water and operation of options (especially during drought periods) included in the portfolio?	Proportion of total supply yield from locally controlled sources	7.5%
		Maximize Supply Diversification	25%	How many independent water supply and demand-side management options above a minimum yield threshold are included in the portfolio?	# of supply/demand-side management sources (above minimum yield threshold)	7.5%
Economic Impacts	20%	Maximize Cost-Effectiveness	75%	What is the total capital (construction) and operations/maintenance costs of all projects/programs in the portfolio over the lifecycle, divided by the sum of all water yield produced by the portfolio?	Unit cost ($/AF) expressed as a present value sum of all costs over the lifecycle, including utility and customer costs.	15%
		Maximize Advantageous External Funding	25%	Does the portfolio have an opportunity for advantageous external funding from Federal, State, local, and private sources?	External Funding Score (1-5), where 1 = low potential and 5 = high potential	5%
Environmental Impacts	20%	Minimize Ecosystem Impacts	40%	To what extent does the portfolio positively or negatively impact receiving water quality (e.g., streams, river, lakes), terrestrial and aquatic habitats throughout Austin, and net streamflow effects both upstream and downstream from Austin?	Ecosystem Impact Score (1-5), where 1 = high combined negative impacts and 5 = high combined positive impacts	8%
		Minimize Net Energy Use	30%	What is the net energy requirement of the portfolio, considering energy generation?	Incremental net change in kWh	6%
		Maximize Water Use Efficiency	30%	What is the reduction in potable water use from water conservation, reuse and rainwater capture for the portfolio?	Potable per capita water use (gallon/person/day)	6%
Social Impacts	15%	Maximize Multi-Benefit Infrastructure/Programs	35%	To what extent does the portfolio provide secondary benefits such as enhanced community livability/beautification, increased water ethic, ecosystem services, or others?	Multiple Benefits Score (1-5), where 1 = low benefits and 5 = high benefits	5.25%
		Maximize Net Benefits to Local Economy	35%	To what extent does the supply reliability and water investments of the portfolio protect and improve local economic vitality, including permanent job creation?	Local Economy Score (1-5), where 1 = high negative impact and 5 = high positive impact	5.25%
		Maximize Social Equity and Environmental Justice	30%	To what extent does the portfolio support social equity and environmental justice, with emphasis on underserved communities?	Social Equity and Environmental Justice Score (1-5), where 1 = significant support and 5 = minimal support	4.5%
Implementation Impacts	15%	Minimize Implementation Challenges	35%	What implementation challenges will the portfolio face in terms of public acceptance, regulatory approval, and legal/institutional barriers?	Implementation Uncertainty Score (1-5), where 1 = high combined challenges and 5 = low combined challenges	5.25%
		Maximize Scalability	35%	To what extent can the portfolio be incrementally sized over time in terms of supply capacity and demand management?	Scalability Score (1-5), where 1 = small incremental sizing potential and 5 = high incremental sizing potential	5.25%
		Minimize Technical Feasibility Challenges	30%	To what extent does the portfolio rely on emerging and/or unproven technologies?	Technical Feasibility (1-5), where 1 = high reliance on emerging or unproven technologies and 5 = low reliance on emerging or unproven technologies	4.5%

Draft Water Forward Objectives and Subobjectives Weighting

- Staff will email Task Force members a link to the online objectives and subobjectives weighting survey
- Task Force input on draft weightings requested by Tuesday, April 25th

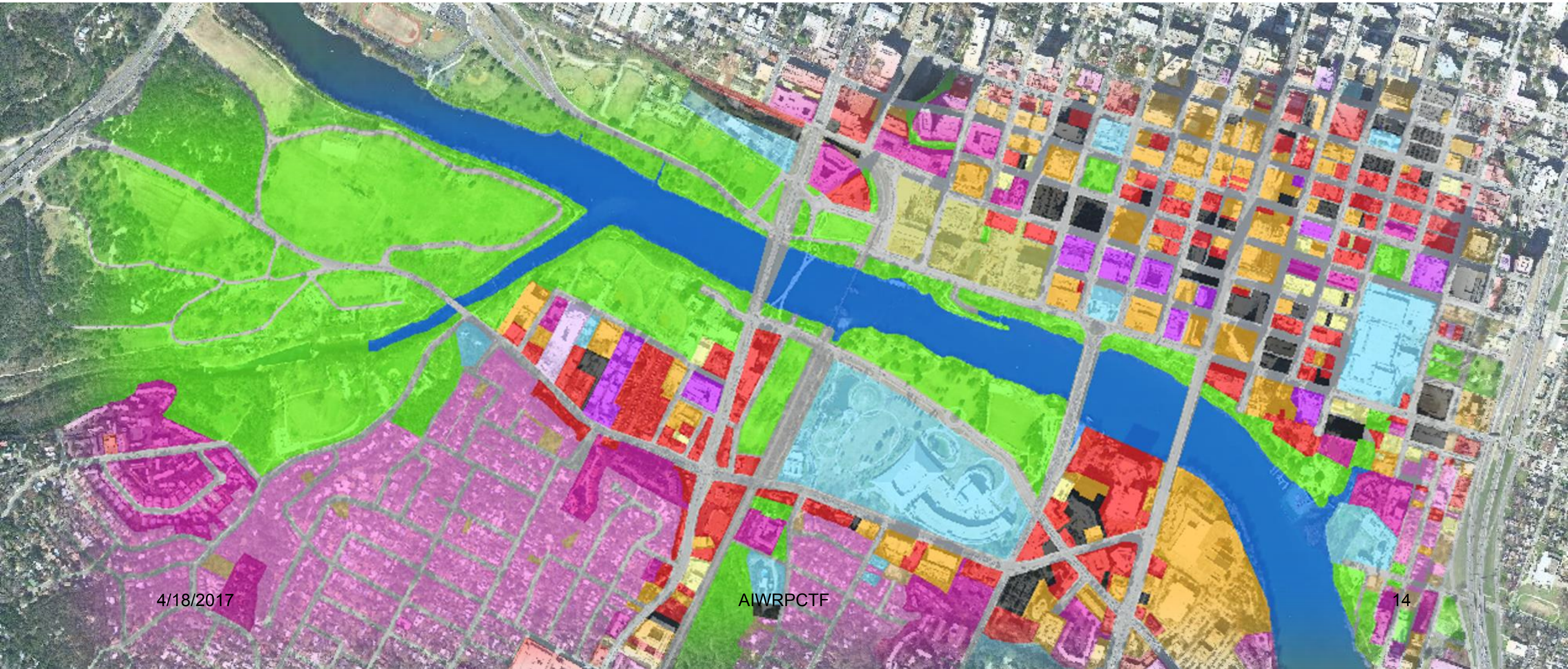
Questions

Decentralized Options

Progress Presentation

Ryan Brotchie, Service Line Leader Integrated Water Management, GHD

Kate Williams, Service Line Leader Spatial Sciences, GHD



Overview

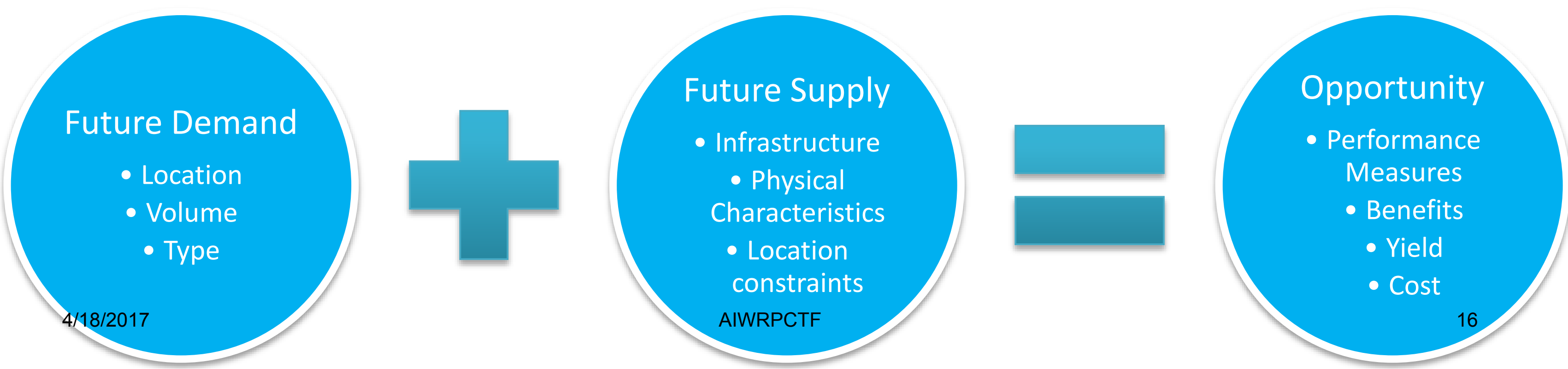
- Program Overview
- Key Progress
- Decentralized Options
  - Lot Scale
    - Rainwater Harvesting
    - Greywater Harvesting
    - Building Scale Wastewater Re-Use
  - Community Scale
    - Stormwater Harvesting
    - Local Wastewater Scalping
    - Distributed Wastewater Reuse
- For Example…

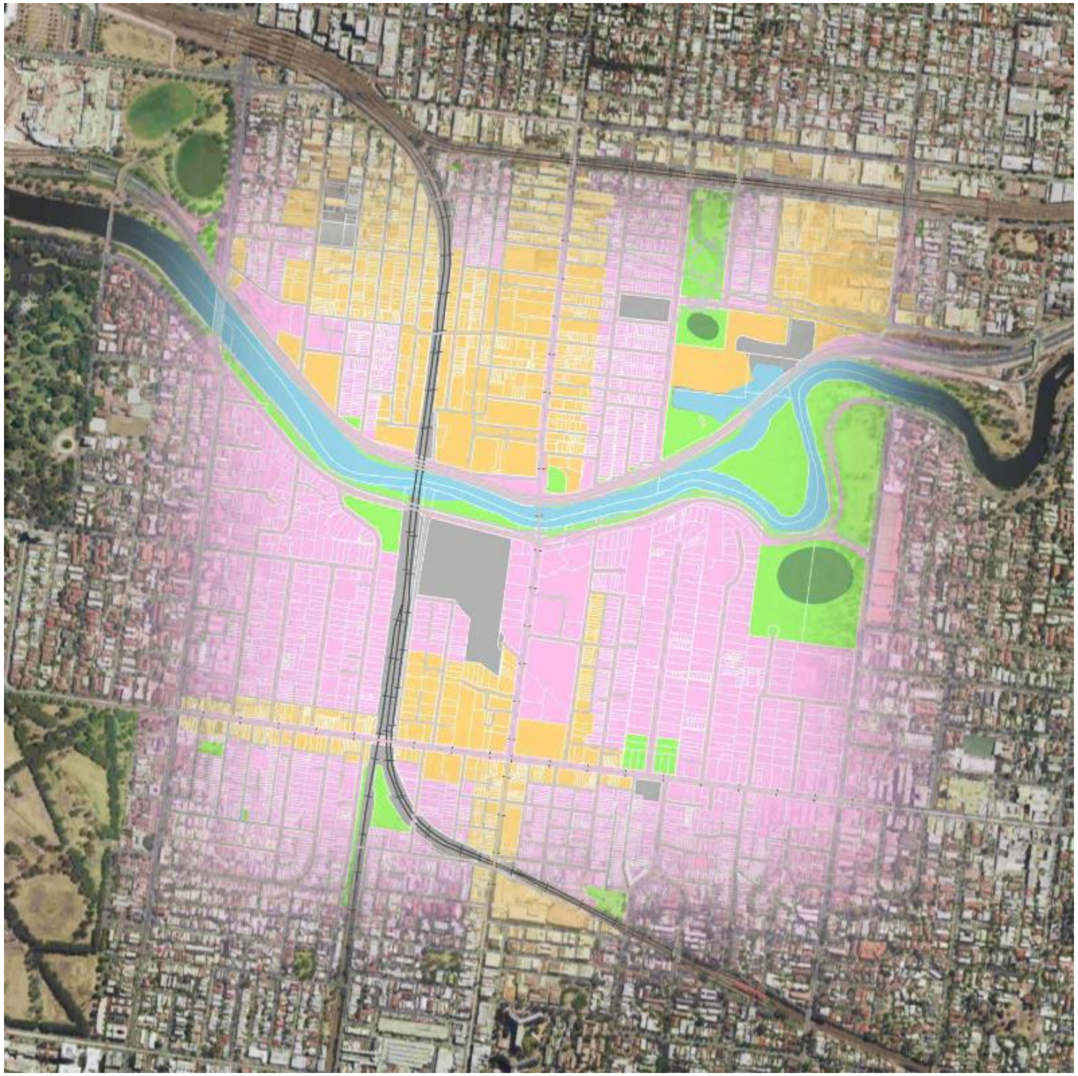
Spatial Analysis

Using spatial information to inform strategic planning in the water sector

- Location
- Spatial variability
- Geometric attributes
- Scale

The potential for different water supply options, now and in the future, can be dependant on physical features and characteristics of the landscape – both natural and built



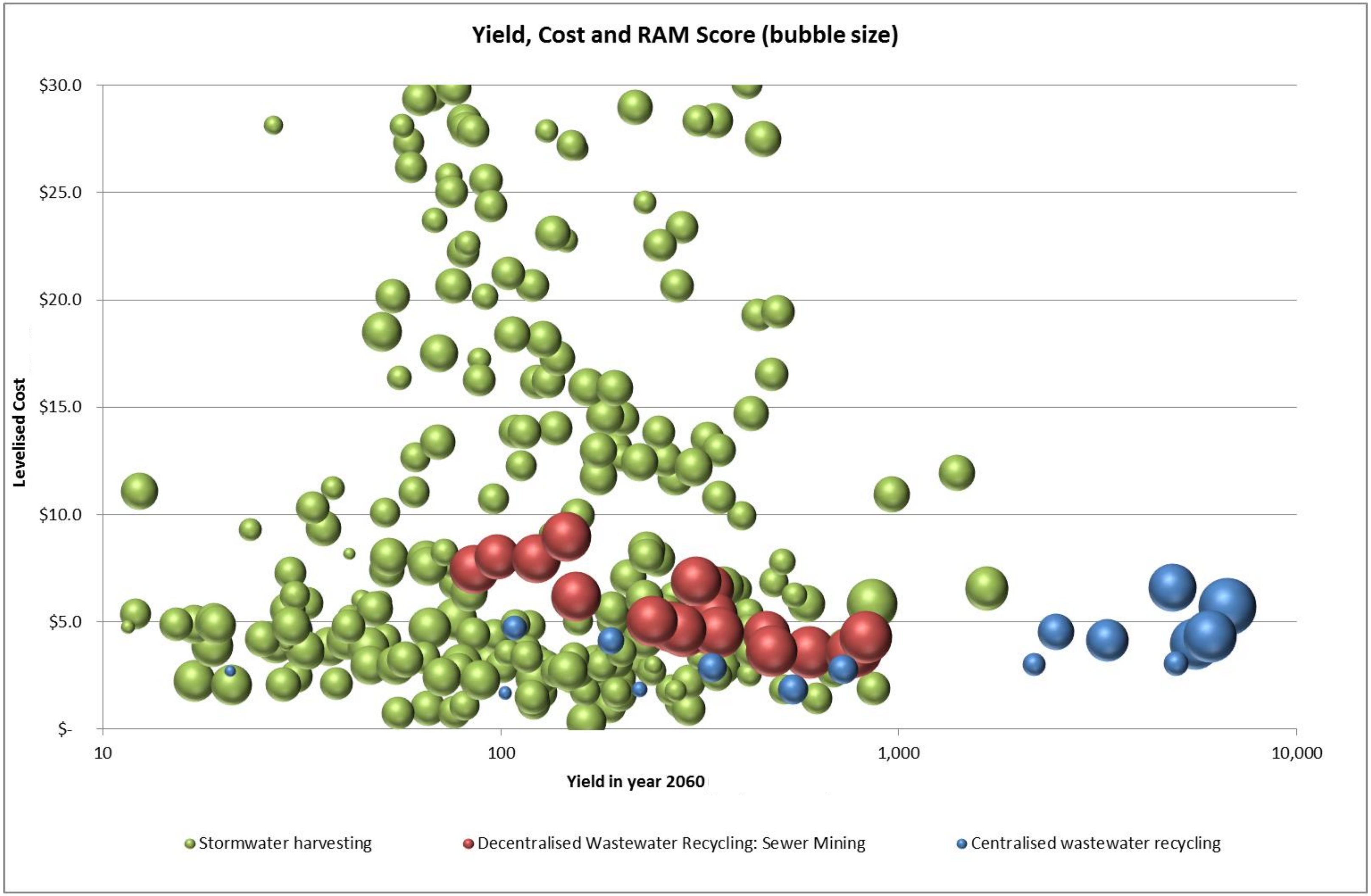


Using Spatial Analysis to:

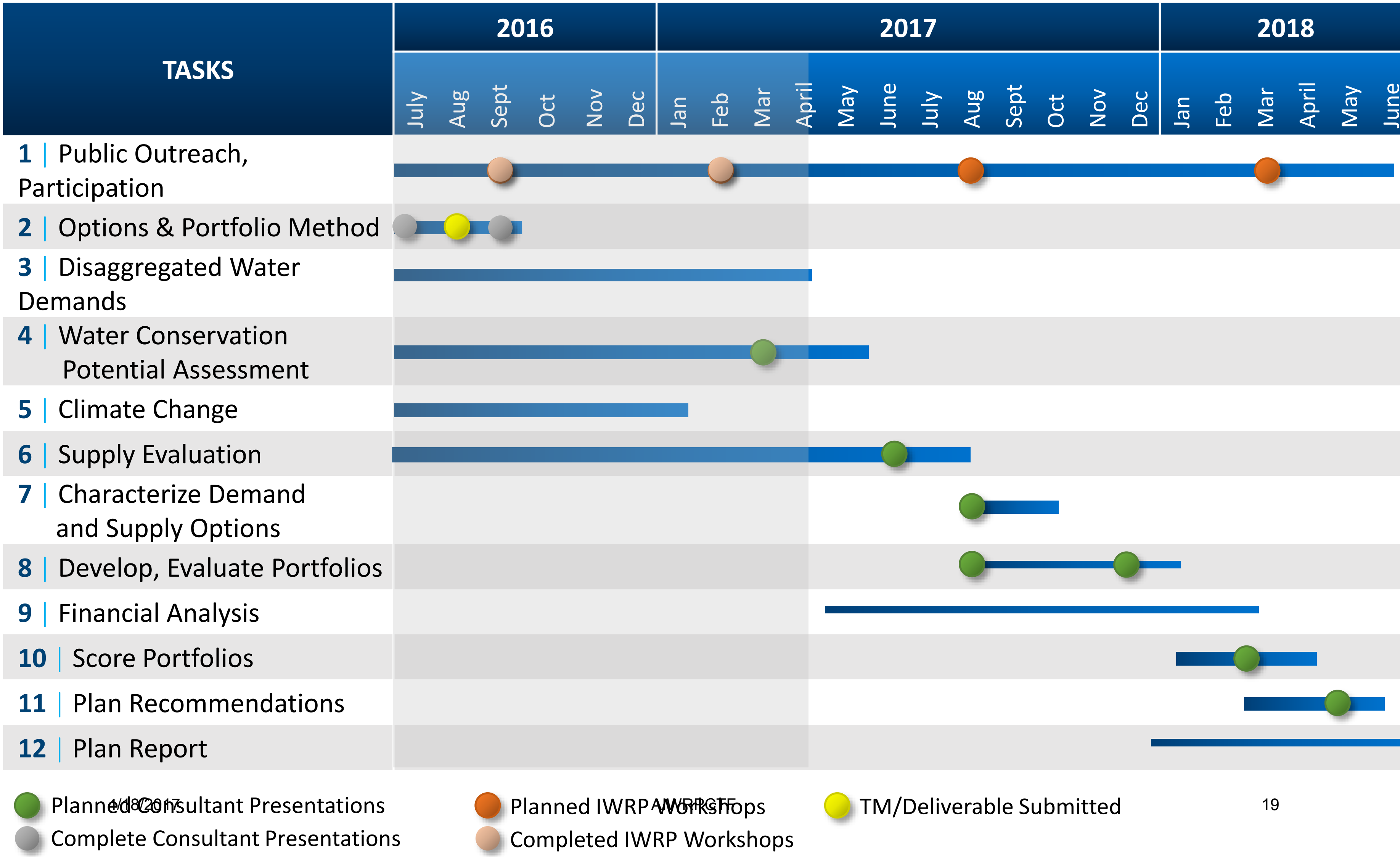
- Identify
- Model
- Cost
- Evaluate

Potential decentralized supply options

Example Decentralized Opportunity Results



Project Schedule



Task 6 – Supply Options Milestone Schedule

April

- April 18, 2017 – Task Force meeting; decentralized analysis overview

May

- May 2, 2017 – Task Force meeting
- May 30, 2017 – screening results delivered to TF

June

- June 6, 2017 – Task Force meeting; options screening results, and characterization approach
- June 14, 2017 – receive feedback on screening of options from TF

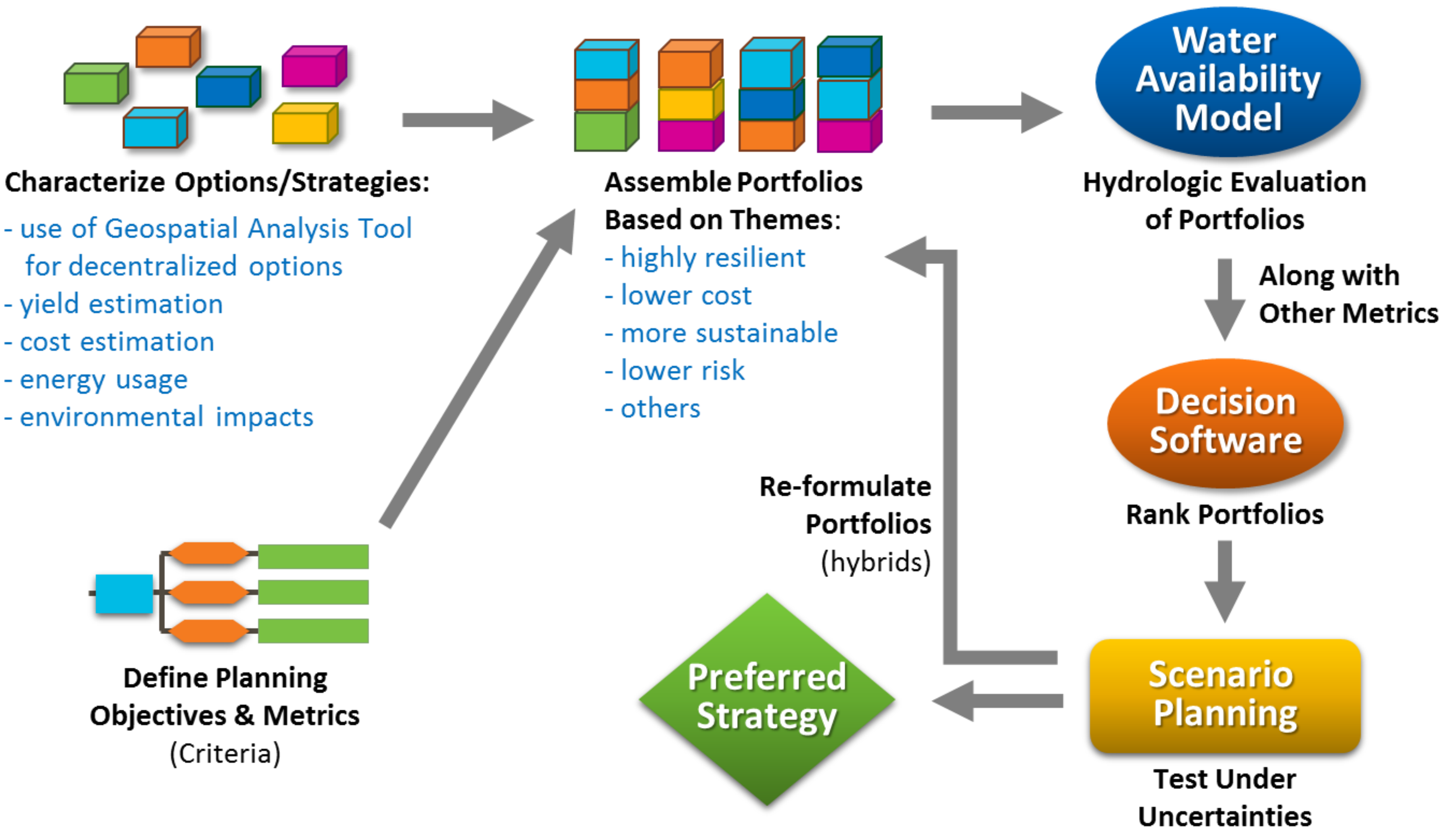
July

- July 11, 2017 – Task Force meeting; final screening of options , progress on characterization
- July 26, 2017 – DRAFT Task 6 memo delivered to TF.

August

- August 1, 2017 – Task Force meeting; supply characterization results
- August 8, 2017 (week of) - Receive feedback on characterization of options from TF; compile TF Task 6 memo comments

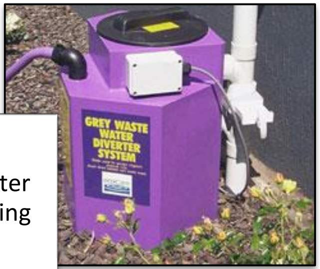
IWRP Planning Process



IWRP Decentralized Options

- Progress to Date
  - Options Definition
  - Options Analysis

Rainwater Harvesting



Greywater Harvesting

Stormwater Harvesting

Building Scale Wastewater Reuse

Local Wastewater Scalping (Sewer Mining)

Distributed Wastewater Reuse

IWRP Decentralized Options - Context

Decentralized Options

Lot scale

- Rainwater Harvesting
- Greywater Harvesting
- Building Scale Wastewater Reuse

Community scale

- Stormwater Harvesting
- Local Wastewater Scalping
- Distributed Wastewater Reuse

10 Demand Management Options

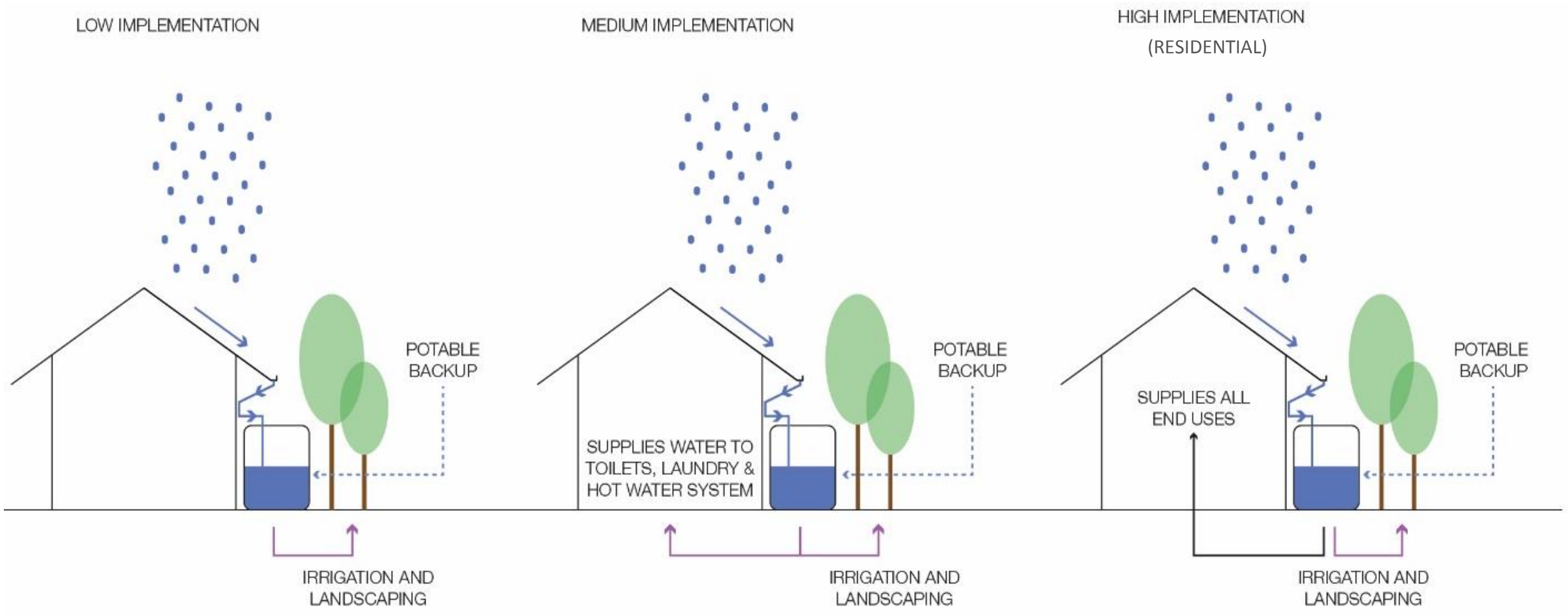
Option Name
…
…
…
…
…
…
Alternative Water Ordinances
…
Alternative Water Incentives
Alternative Water Incentives – Graywater and Blackwater

21 Supply Options

Option Name
…
…
…
Stormwater Harvesting
Local Wastewater Scalping (Sewer Mining)
Distributed Wastewater Reuse
…
…
…
…

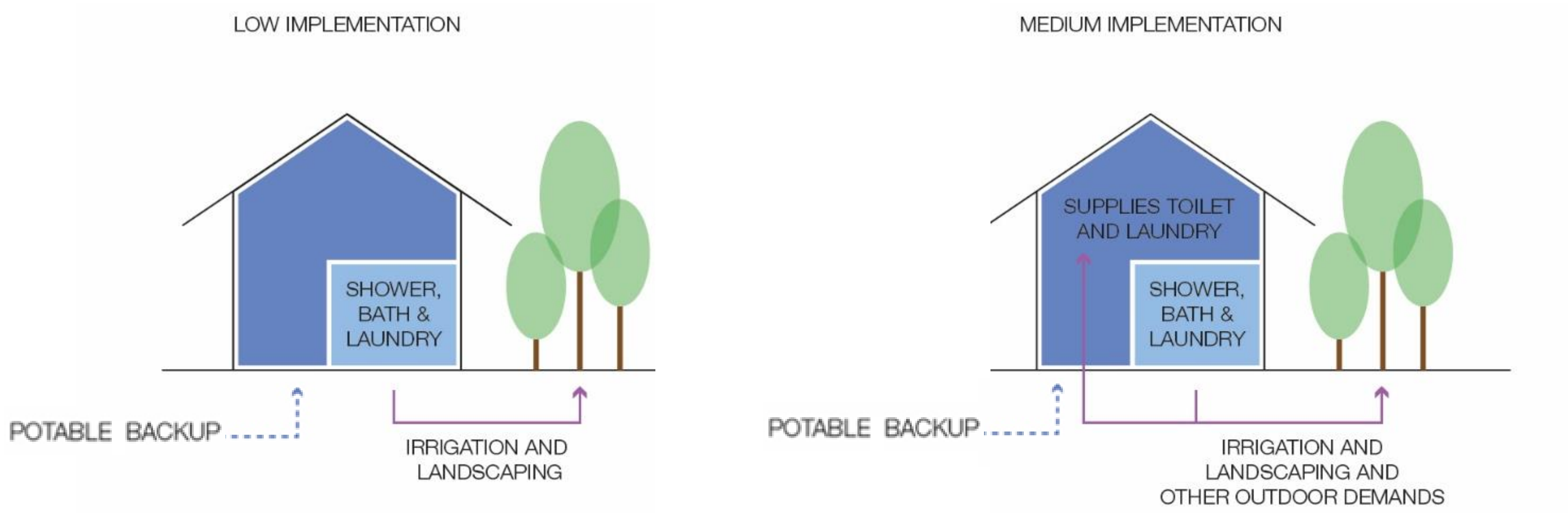
Lot Scale Options

Rainwater Harvesting



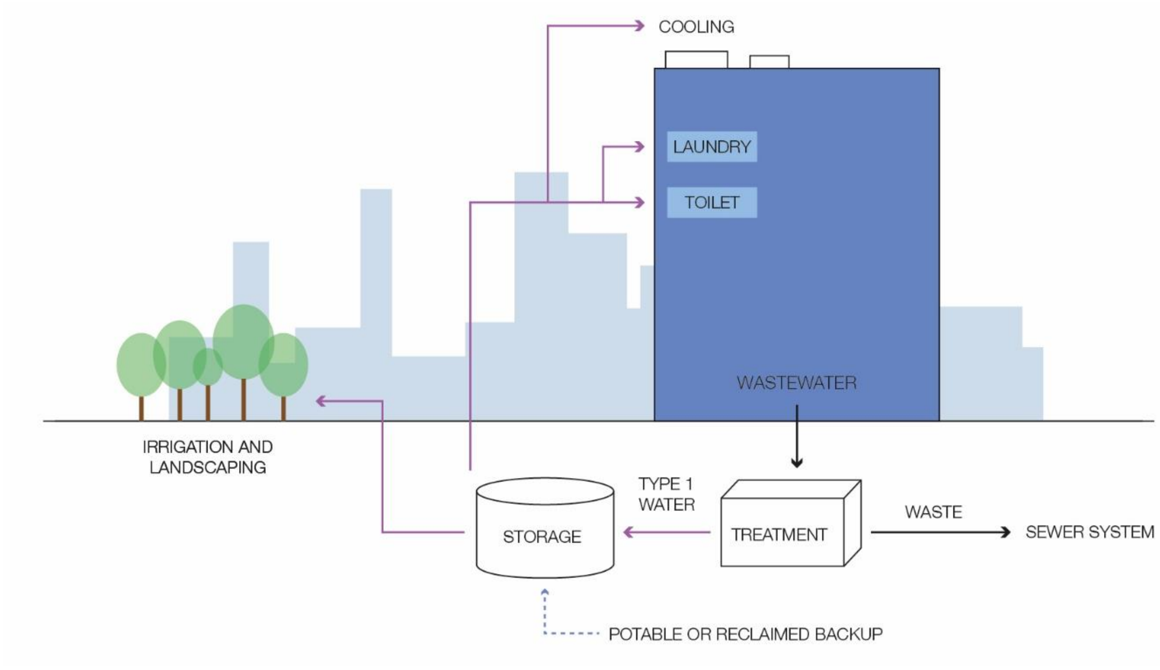
…the capture and storage of roof water to supply a range of onsite demands at the lot/building scale.

Greywater Harvesting



…the reuse of greywater (water from the laundry, shower, bath and hand basins) at the lot/unit scale, to supply landscape irrigation demands, and with treatment, to supply toilet flushing and clothes washing demands.

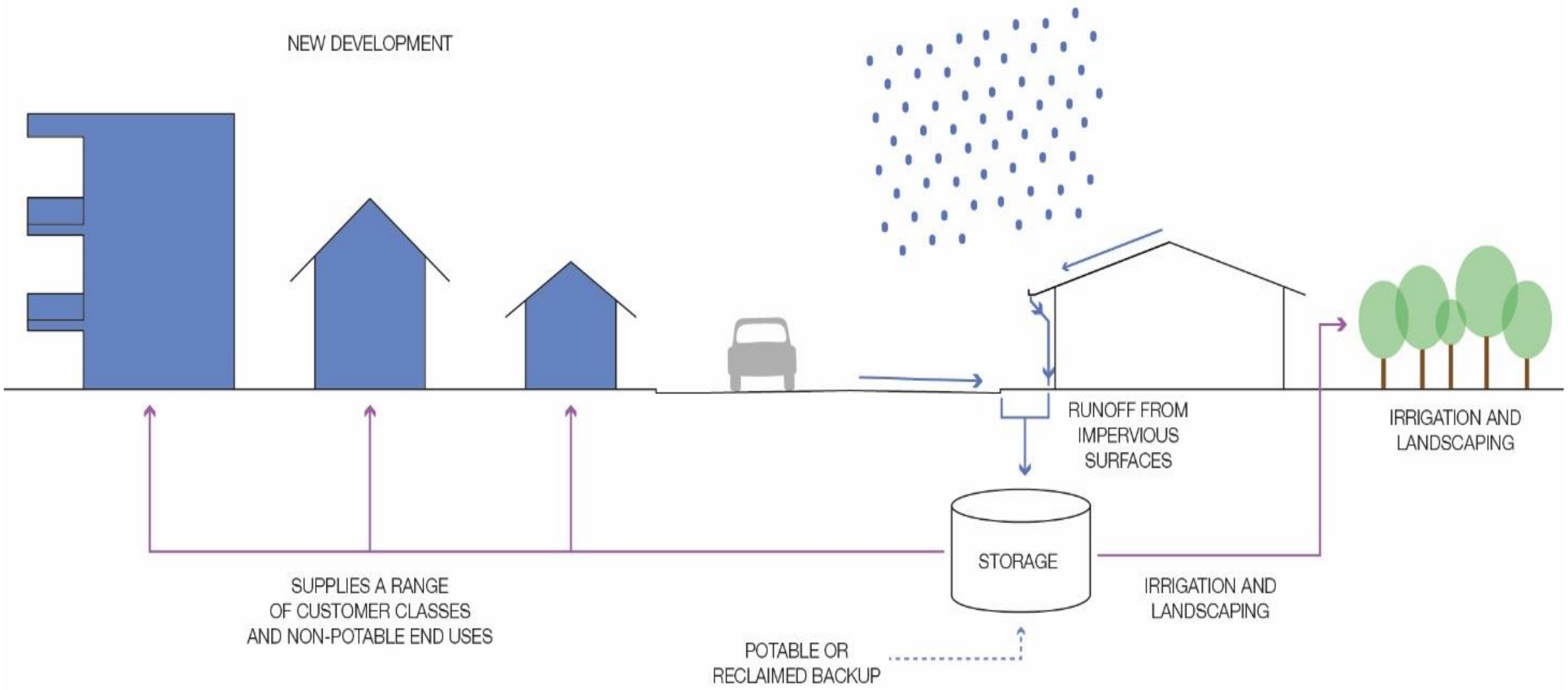
Building Scale Wastewater Re-Use



…the onsite capture and treatment of the wastewater stream generated in a typically high density, multi-storey building for reuse on site.

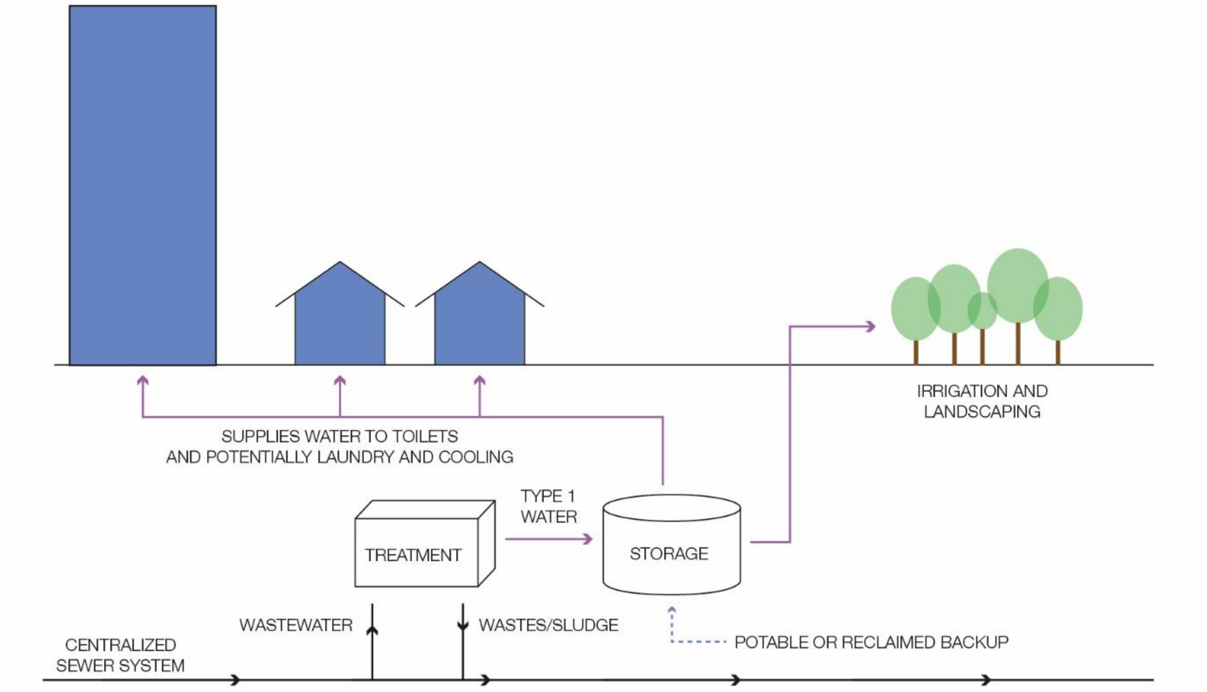
Community Scale Options

Stormwater Harvesting



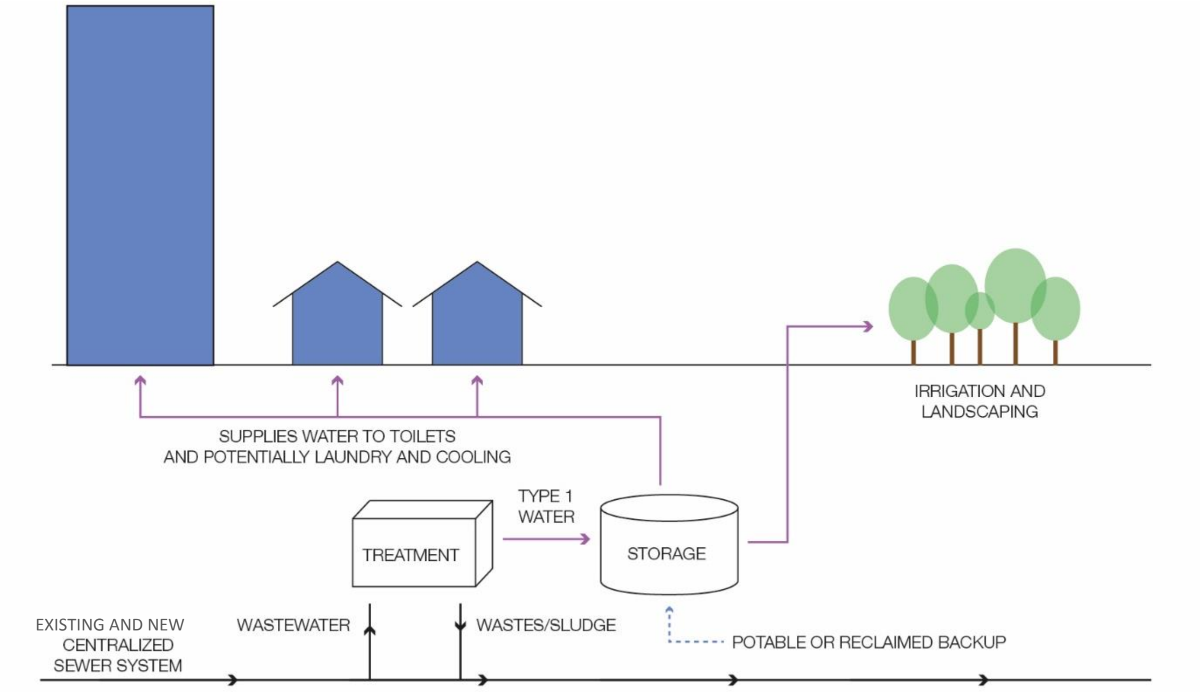
…the collection and reuse of excess stormwater runoff from urban areas (e.g. impervious surfaces including roads, pavements and roofs).

Wastewater Scalping (Sewer Mining)



…the extraction (mining or scalping) of wastewater from the sewer system, treatment to Type 1 quality, and reuse at the local/community scale.

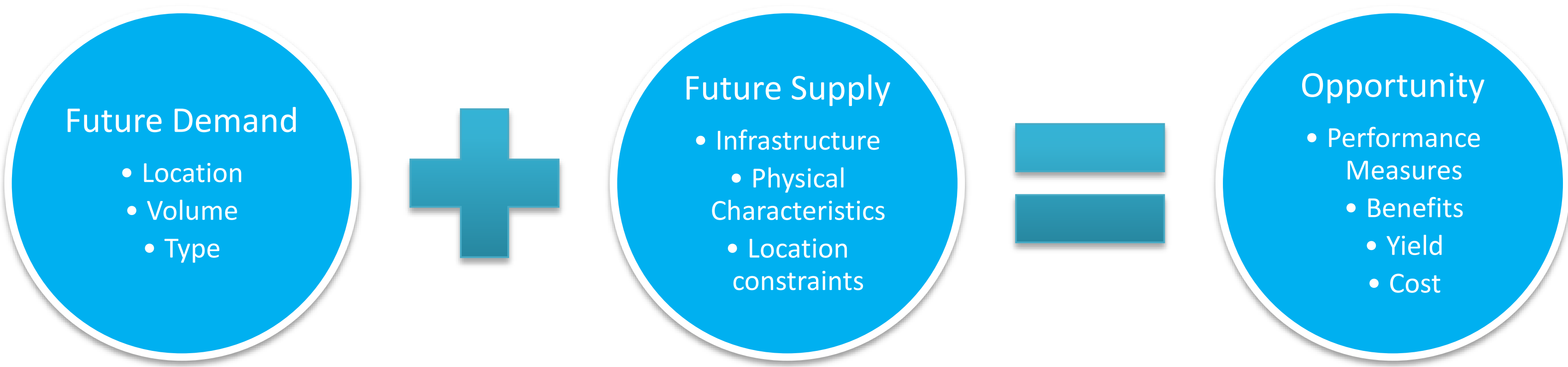
Distributed Wastewater



…the collection and treatment of wastewater (to Type 1 quality) at a distributed/community scale in areas with new development

Spatial Method

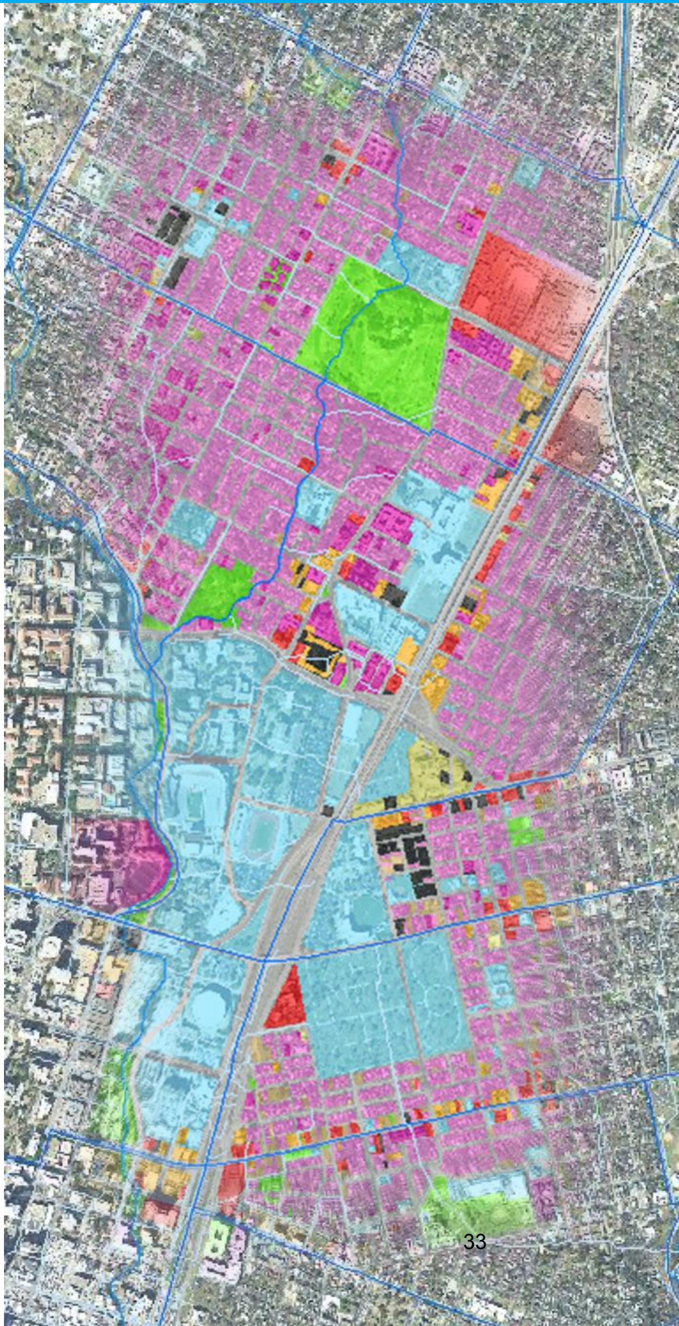
- Scale – Lot and Community



Example Concepts, Data and Analysis

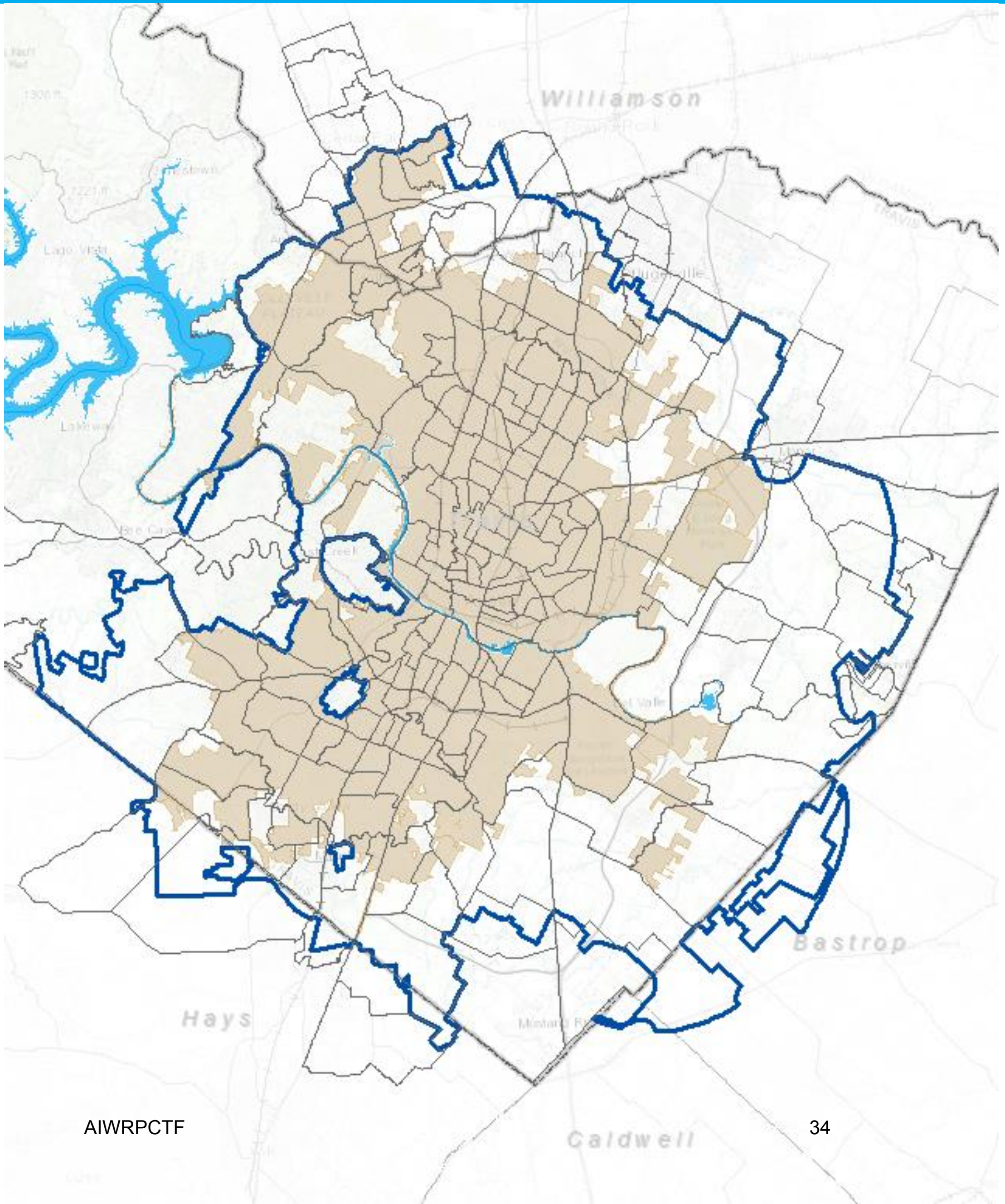
- DTI* Level Reporting
- Land Use Change and Growth
- Rainwater Harvesting

*Delphi, Trends, Imagine Austin



DTI Polygons

- #230
- Outputs will be aggregated to DTI level

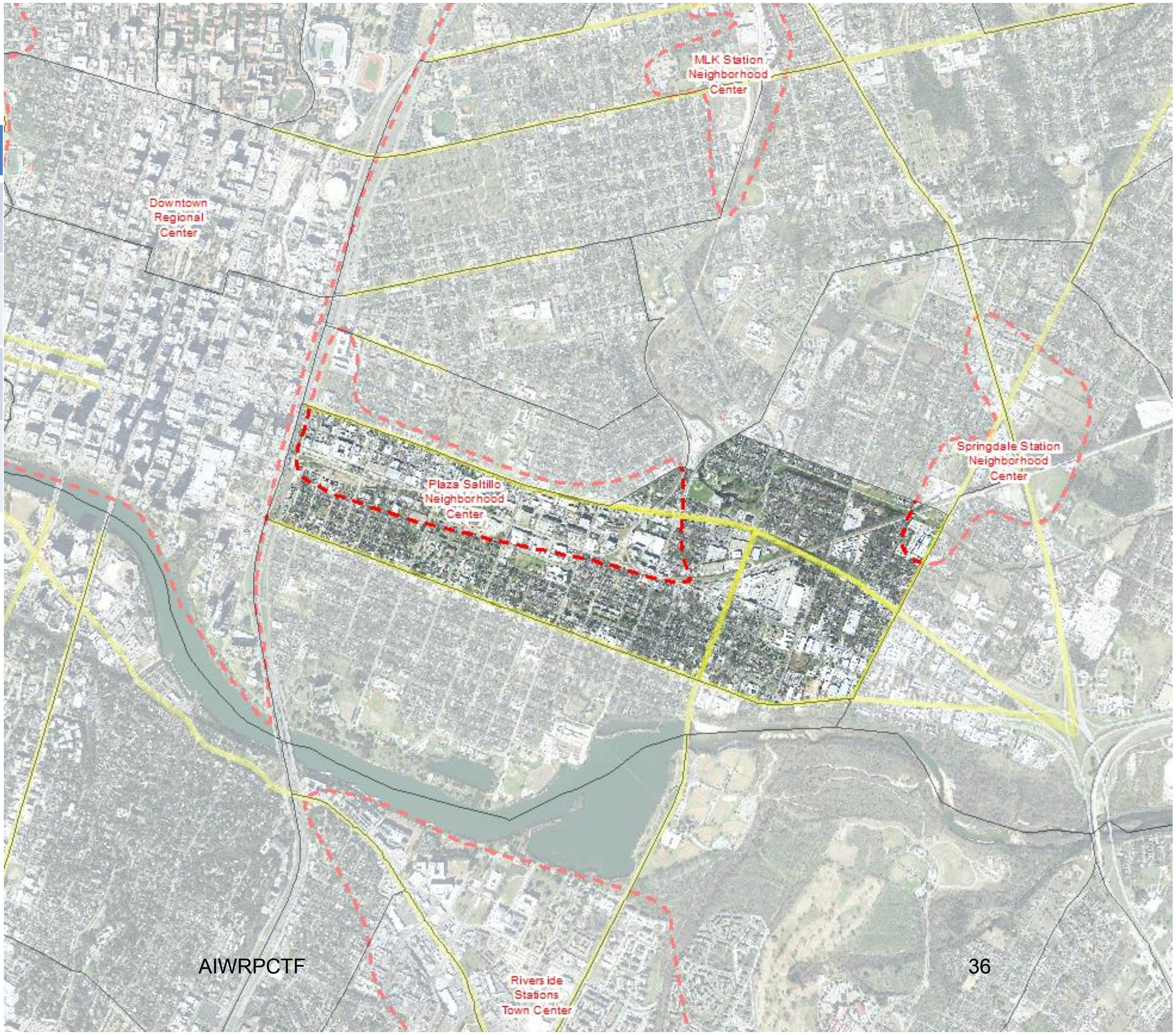


Land Use Change and Growth Greenfield

DTI 207	2015	2070
Unit SFR	0	9,825
Unit MFR	0	15,294

Land Use Change and Growth Existing Urban Area

DTI 84	2015	2070
Unit SFR	1,214	2,327
Baseline Demand SFR	62,448,931	109,562,685
Unit MFR	1,054	2,541
Baseline Demand MFR	44,374,750	95,980,881



Rainwater Harvesting at 2070

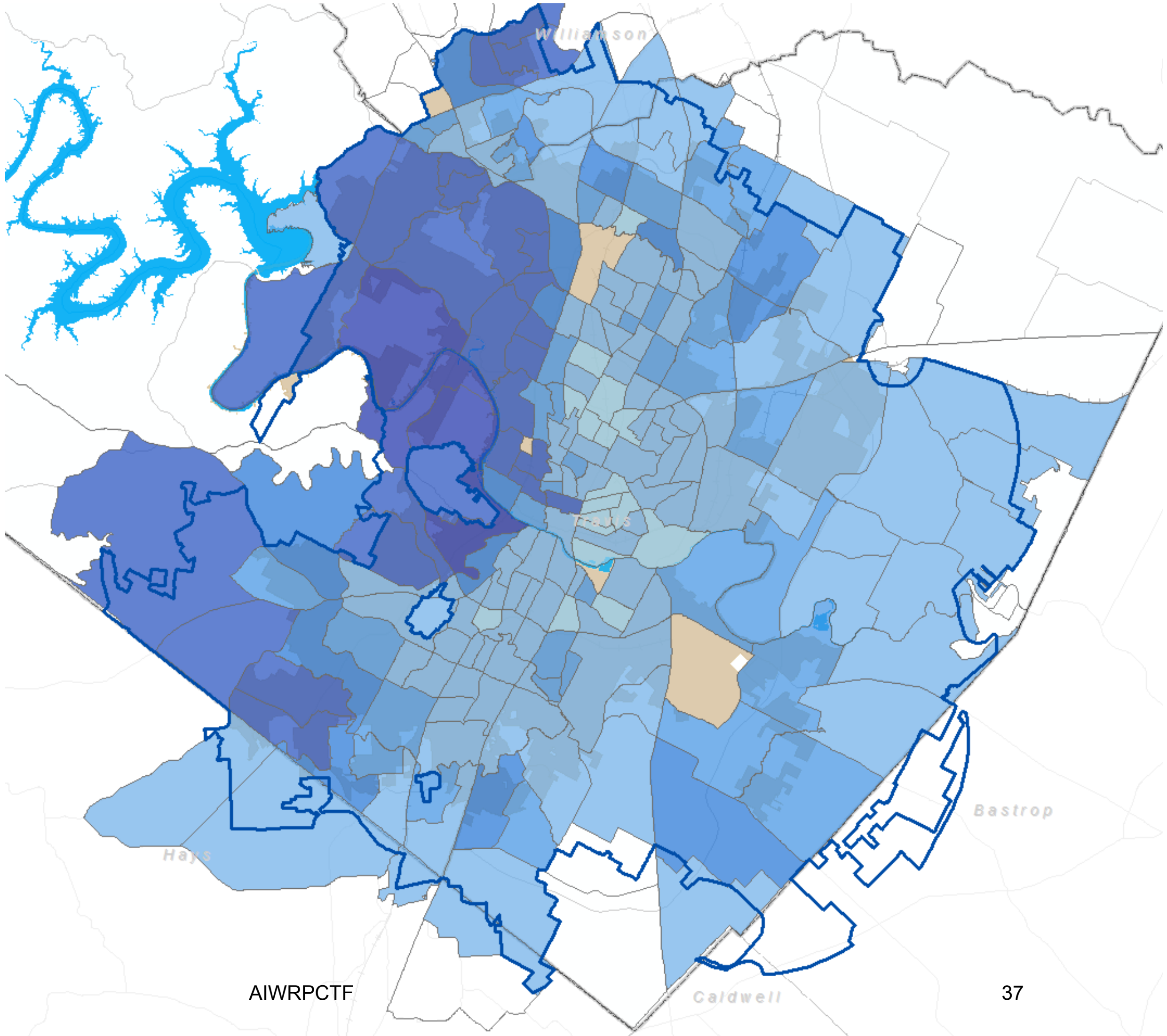
Example 1

Rainwater yield per SFR house using 1,000 gallon tank to supply irrigation/landscaping

Varies due to:

- Demand
- Housing (Roof Size)

Yield per SFR Unit per Year



Rainwater Harvesting at 2070

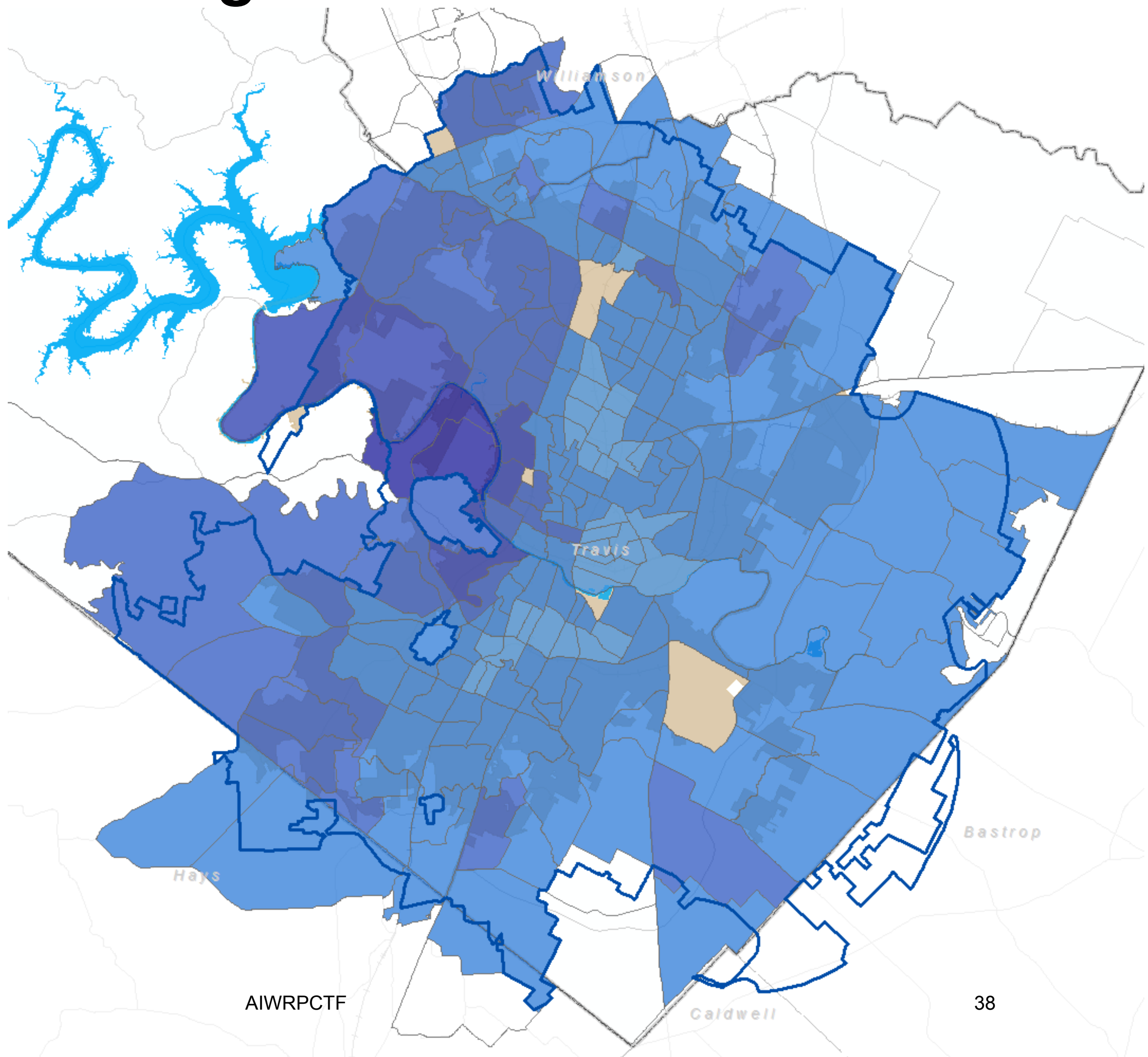
Example 2

Rainwater yield per SFR house using 1,000 gallon tank to supply irrigation/landscaping + toilets + clothes washers

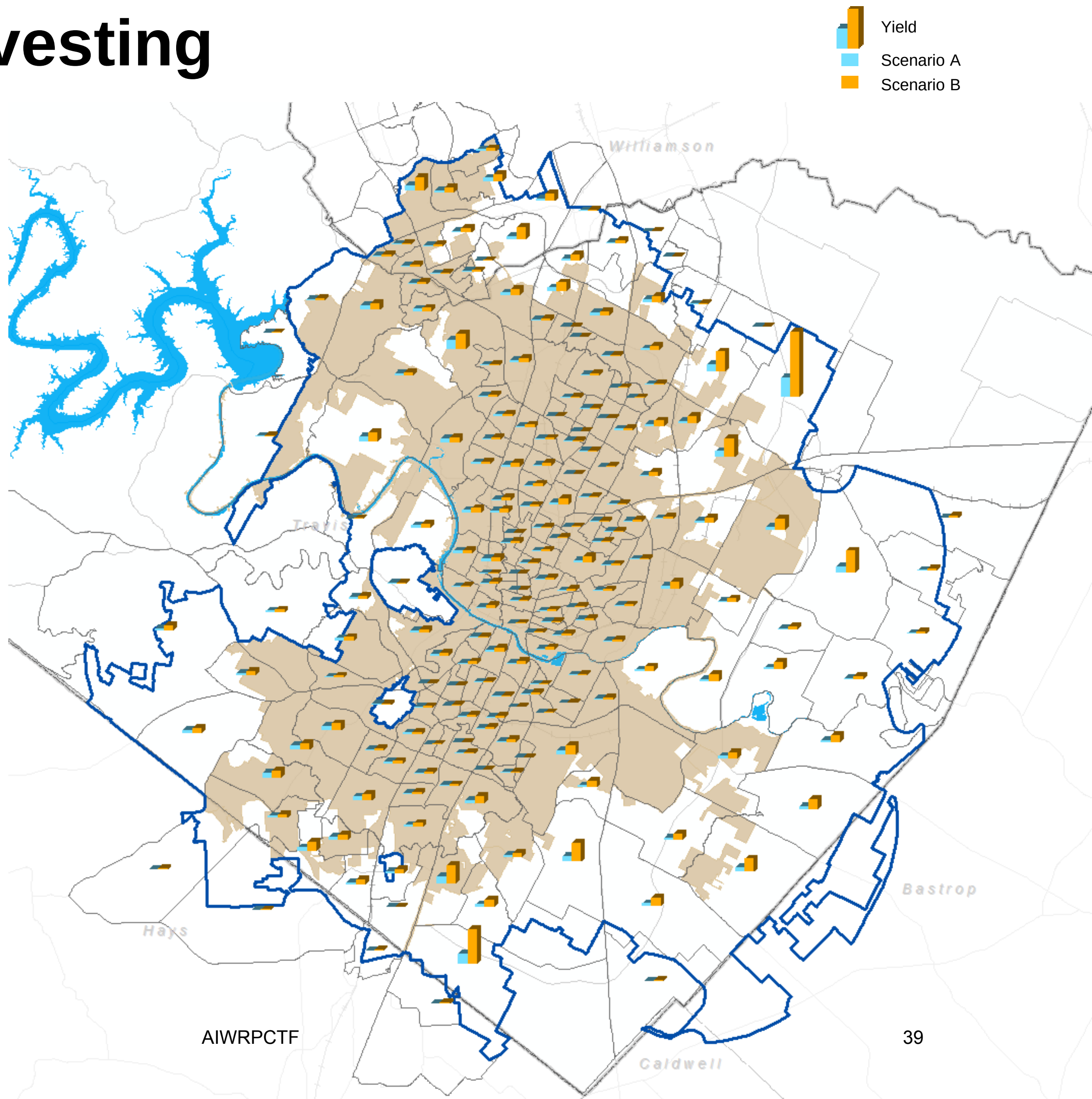
Results in:

- Increased yields

Yield per SFR Unit per Year



Rainwater Harvesting

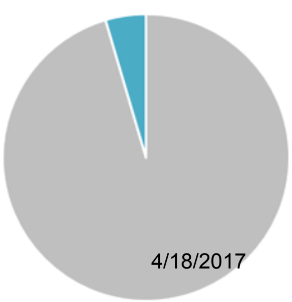


Example 3

Total SFR rainwater yields at 2070 for each DTI

Proportion of total SFR demand supplied by Rainwater at 2070

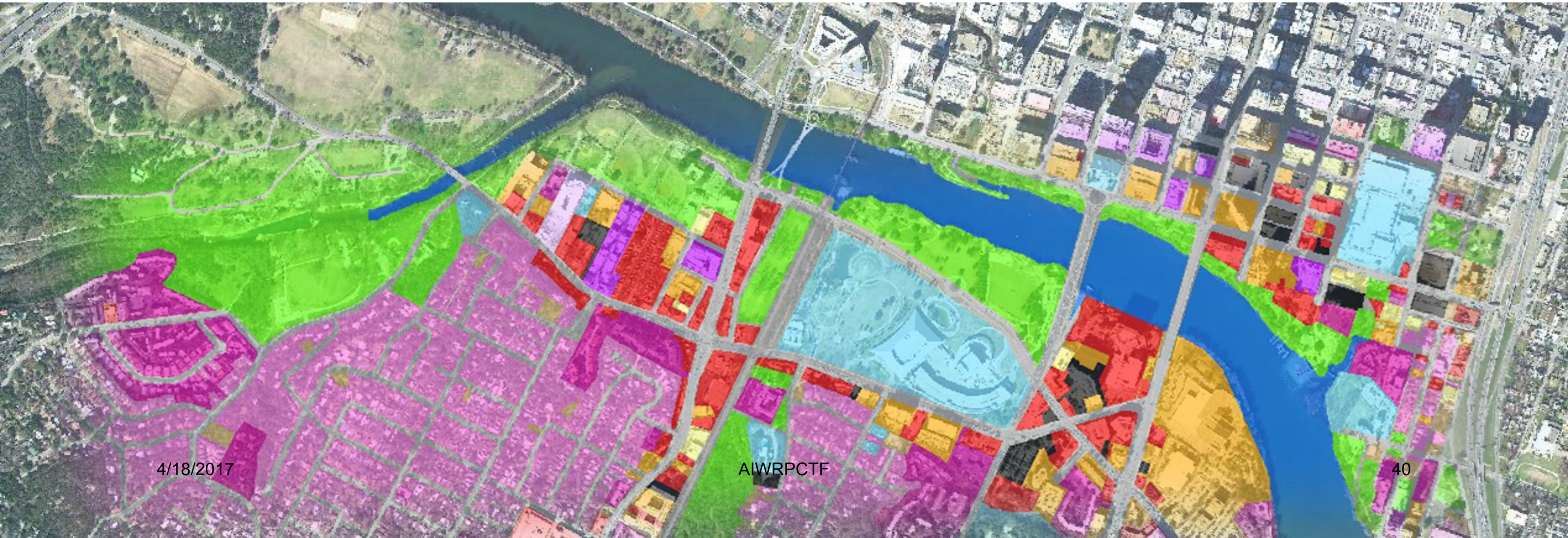
Scenario A



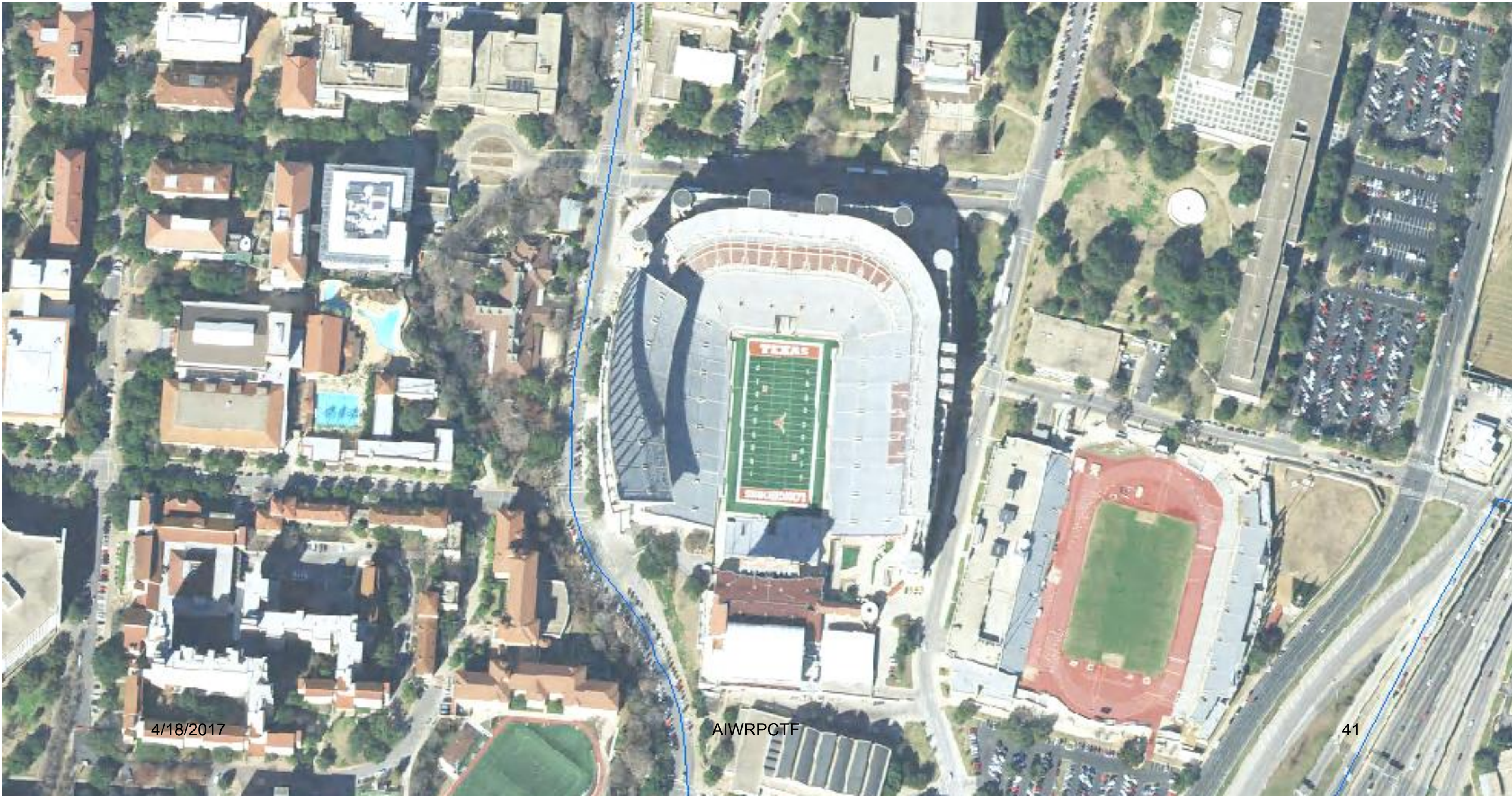
Scenario B

Next Steps

- Screening – yield, cost, implementation ability
- Characterize Options
- Incorporate into Portfolios



Questions?



AUSTIN WATER

100

YEARS

RELIABLE SERVICES

BACKUP MATERIALS

Water Forward: Draft Integrated Water Resources Plan Objectives

Primary Objective	Objective Weight	Sub-Objective	Sub-Objective Weight	Defining Question	Performance Measure	
Water Supply Benefits	30%	Maximize Water Reliability	50%	How does the portfolio perform in terms of reliability (how often is there shortage), vulnerability (how large is the shortage), recovery (how fast is the recovery from shortages) under various hydrologic conditions, including climate change scenarios?	Water Supply Index (0 to 1) based on WAM modeling results	15%
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Memorandum - DRAFT

To: *Marisa Flores Gonzalez, Austin Water*

From: *Dan Rodrigo and Chris Kurtz, PE, CDM Smith*

Copied: *Teresa Lutes, Austin Water; Tina Petersen, CDM Smith*

Date: *April7, 201714*

Subject: *Austin Water Integrated Water Resources Plan:*
Task No. 2 – Methodology for Options and Portfolio Evaluation. Revised.
CDM P/N: 0590-114879

The Water Forward Integrated Water Resources Plan (IWRP) is a comprehensive planning process being undertaken by Austin Water (AW) to evaluate water supply and demand management options. The Mission Statement for the IWRP is as follows:

> *The Integrated Water Resource Plan (IWRP) will provide a mid- and long-term evaluation of, and plan for, water supply and demand management options for the City of Austin in a regional water supply context.*
>
> *Through public outreach and coordination of efforts between City departments and the Austin Integrated Water Resource Planning Community Task Force (Task Force), the IWRP offers a holistic and inclusive approach to water resource planning.*
>
> *The plan embraces an innovative and integrated water management process with the goal of ensuring a diversified, sustainable, and resilient water future, with strong emphasis on water conservation.*

The purpose of this memorandum is to provide an overview of how demand-side and supply options will be screened and characterized. It also establishes the primary objectives, sub-objectives, and performance measures that will be used to evaluate portfolios (combinations of individual options). Above all, it provides the framework for how the IWRP will provide a transparent, unbiased analysis of the tradeoffs between various portfolios to meet the IWRP objectives.

1.0 Preliminary Estimation of Water Supply Needs

An important aspect of the IWRP is to evaluate existing water supplies under different hydrologic conditions and compare these supplies to forecasted water demands. This will provide preliminary estimates of short-term, medium-term and long-term water supply needs. The Colorado River Basin Water Availability Model (WAM) will be used for evaluation of future water supply needs for the forecasted demands in years 2020, 2040, 2070 and 2115, under different hydrologic scenarios which are planned to include the historical hydrologic period of record, climate change adjusted hydrology, and randomized re-sequenced hydrology.

Forecasted demands will be simulated against various hydrologic scenarios, and measures of supply shortage will be produced. No portfolios of water supply or demand-side options will be used in this preliminary water supply needs analysis. The purpose of this assessment will be to gain an understanding of the characteristics of potential water supply needs. Subsequent tasks in the IWRP process will take this and other information into account in the development of portfolios.

1.1 Evaluation Process Overview

The Austin IWRP evaluation process is based on a proven planning process that explores both demand-side and supply-side options in an integrated manner in order to meet multiple objectives. The IWRP process also explores risks and uncertainty related to different potential hydrologic and climatic futures over the next 100 years.

In development of the IWRP, the following terms will be used:

Objectives	• Broadly stated goals of the IWRP that drive the evaluation process.
Sub-objectives	• Adds further clarity to the objectives, and forms the basis for the evaluation criteria used to score portfolios.
Performance Measures	• Metrics that indicate how well sub-objectives are being achieved.
Options	• Individual water supply and demand-side management projects or programs.
Portfolios	• Combinations of options that are evaluated against the performance measures.

The IWRP process is summarized in **Figure 1**. The process begins with defining the objectives, sub-objectives, and performance measures. The sub-objectives together with the performance measures serve as the evaluation criteria by which IWRP portfolios will be measured against.

Prior to developing portfolios, identification and characterization of various water supply and demand-side options will take place. The process will start with a larger number of options, which will be screened down to a smaller number using a set of criteria. These criteria will include a high-level unit-cost comparison and a high-level implementation risk comparison. Those options that pass the screening process will be evaluated and characterized in greater detail. This process of characterization of water supply and demand-side options will be summarized in subsequent technical memoranda.

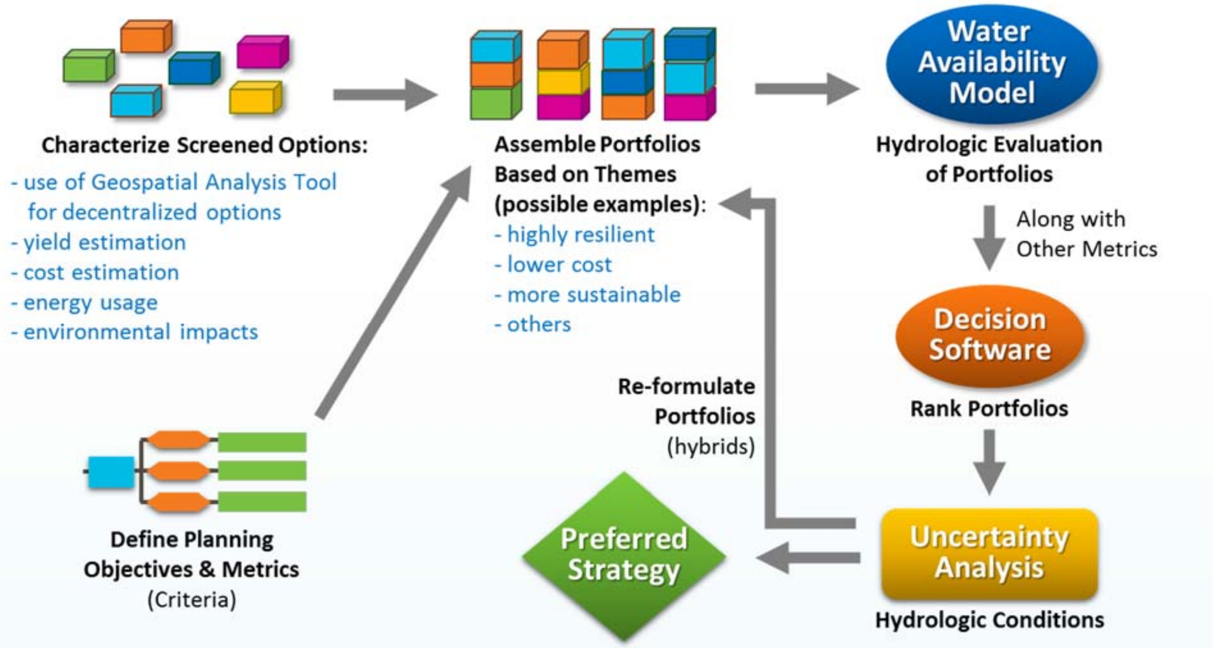

Figure 1 – AW IWRP Planning Process

Because no single option can meet all of the IWRP objectives and sub-objectives, multiple options will be combined in various ways to develop portfolios. The portfolios will be developed around themes such as "High Resiliency" or "Lower Cost" or "High Stewardship". Themes will be developed by AW with input from the Task Force. Each portfolio will then be evaluated in terms of how well they achieve the sub-objectives, under various hydrologic conditions (for example historical and climate change scenarios). Ultimately, the portfolios will be ranked and a preferred IWRP strategy will be recommended for implementation. The preferred IWRP strategy may be a combination of several high-ranking portfolios using an adaptive management approach that would implement various options within the portfolios based on triggers, such as demand growth, hydrologic conditions and other factors.

1.2 Objectives and Performance Measures

The IWRP planning objectives serve as the framework for how the IWRP is developed. Objectives are usually categorized into primary and secondary (or sub-objectives). Primary objectives are more general, while sub-objectives help define the primary objectives in more specific terms. Note that throughout this memorandum the terms *objective* and *primary objective* are used interchangeably. Based on decision science literature and consulting best practices, sub-objectives should have the following attributes:

- **Be Distinctive:** to distinguish between one portfolio and another
- **Be Measurable:** in order to determine if they are being achieved, either through quantitative or qualitative metrics
- **Be Non-Redundant:** to avoid overlap and avoid bias the ranking of portfolios
- **Be Understandable:** be easily explainable and clear
- **Be Concise:** to focus on what is most important in decision-making

The IWRP objectives and sub-objectives were developed by AW/consultant team, with input from the Task Force. The objectives were formulated based on the previous 2014 Task Force, and centered around principles of sustainability (balanced between economic, environmental, social needs). Initial sub-objectives were formulated with a "defining question" to establish the intent of the sub-objective. A preliminary list of 25 draft sub-objectives was developed as part of a full day workshop held with the AW/consultant team. Based on input from the Water Forward Task Force (previously referred to as IWRP Task Force) through a survey, the sub-objectives were reduced to 14, which aligns well with decision science literature and consulting best practices.

For each sub-objective, a performance measure is required. The performance measure is used to indicate how well a sub-objective is being achieved. Where possible, quantitative performance measures were established based on a review of available data and anticipated output from the various IWRP analyses, tools, and modeling efforts. In certain instances, a qualitative score is the most suitable performance measure. Qualitative scores will be established based on a combination of quantitative analysis, professional judgment, and input from subject matter experts, including AW staff/consultant team. **Table 1** presents the refined list of primary objectives, sub-objectives and performance measures.

In any decision-making process, primary objectives are generally not all equally important. Thus, developing a set of weights is necessary to better reflect the difference in values and preferences among the various objectives. The AW/consultant team will initially develop a draft set of weights for the objectives and sub-objectives. The weighting of objectives from the 2014 Task Force process will be considered in developing the initial draft weighting set.

A survey will be sent out to the Water Forward Task Force with the draft weightings for objectives and sub-objectives that will be used to solicit input on the draft weightings. This survey information will be provided for review and discussion by the Water Forward Task Force. Additional input provided will be considered by AW and the consultant team in the process of refining the weighting set.

Table 1 Objectives, Sub-objectives, Defining Question, and Performance Measures

Primary Objective	Sub-Objective	Defining Question	Performance Measure
Water Supply Benefits	Maximize Water Reliability	How does the portfolio perform in terms of reliability (how often is there shortage), vulnerability (how large is the shortage), recovery (how fast is the recovery from shortages) under various hydrologic conditions (including climate change scenarios)?	Water Supply Index (0 to 1) based on WAM modeling results
	Maximize Local Control	To what extent does AW have control over the quantity and storage of water and operation of options (especially during drought periods) included in the portfolio?	Proportion of total supply yield from locally controlled sources
	Maximize Supply Diversification	How many independent water supply and demand-side management options above a minimum yield threshold are included in the portfolio?	# of supply/demand-side management sources (above minimum yield threshold)
Economic Impacts	Maximize Cost-Effectiveness	What is the total capital (construction) and operations/maintenance costs of all projects/programs in the portfolio over the lifecycle, divided by the sum of all water yield produced by the portfolio?	Unit cost ($/AF) expressed as a present value sum of all costs over the lifecycle, including utility and customer costs.
	Maximize Advantageous External Funding	Does the portfolio have an opportunity for advantageous external funding from Federal, State, local, and private sources?	External Funding Score (1-5), where 1 = low potential and 5 = high potential
Environmental Impacts	Minimize Ecosystem Impacts	To what extent does the portfolio positively or negatively impact receiving water quality (e.g., streams, river, lakes), terrestrial and aquatic habitats throughout Austin, and net streamflow effects both upstream and downstream from Austin?	Ecosystem Impact Score (1-5), where 1 = high combined negative impacts and 5 = high combined positive impacts
	Minimize Net Energy Use	What is the net energy requirement of the portfolio, considering energy generation?	Incremental net change in kWh
	Maximize Water Use Efficiency	What is the reduction in potable water use from water conservation, reuse and rainwater capture for the portfolio?	Potable per capita water use (gallon/person/day)
Social Impacts	Maximize Multi-Benefit Infrastructure/Programs	To what extent does the portfolio provide secondary benefits such as enhanced community livability/beautification, increased water ethic, ecosystem services, or others?	Multiple Benefits Score (1-5), where 1 = low benefits and 5 = high benefits
	Maximize Net Benefits to Local Economy	To what extent does the supply reliability and water investments of the portfolio protect and improve local economic vitality, including permanent job creation?	Local Economy Score (1-5), where 1 = high negative impact and 5 = high positive impact
	Maximize Social Equity and Environmental Justice	To what extent does the portfolio support social equity and environmental justice, with emphasis on underserved communities?	Social Equity and Environmental Justice Score (1-5), where 1 = significant support and 5 = minimal support
Implementation Impacts	Minimize Implementation Challenges	What implementation challenges will the portfolio face in terms of public acceptance, regulatory approval, and legal/institutional barriers?	Implementation Uncertainty Score (1-5), where 1 = high combined challenges and 5 = low combined challenges
	Maximize Scalability	To what extent can the portfolio be incrementally sized over time in terms of supply capacity and demand management?	Scalability Score (1-5), where 1 = small incremental sizing potential and 5 = high incremental sizing potential
	Minimize Technical Feasibility Challenges	To what extent does the portfolio rely on emerging and/or unproven technologies?	Technical Feasibility (1-5), where 1 = high reliance on emerging or unproven technologies and 5 = low reliance on emerging or unproven technologies

1.3 Options Screening and Characterization

Prior to developing portfolios for detailed evaluation, it is important to evaluate individual supply and demand-side options. This allows for more informed portfolio development and ultimately portfolios that are better at meeting overall IWRP objectives. To do this, two key steps are required: options screening and a standardized options characterization process.

1.3.1 Options Screening Method

Approximately 22 water supply options and 25 demand-side options will be identified for initial screening by AW/consultant team. Through the screening process these 47 options will be narrowed down to a total of 20 supply and demand-side options (10 supply-side and 10 demand-side) that will be carried forward for further characterization. The anticipated list of options identified for screening will fall under the following main categories:

- Surface Water Supply Options
- Aquifer Storage and Groundwater Options (for example, desalination of brackish groundwater)
- Decentralized Options (for example, graywater/black water, rainwater harvesting)
- Reuse Options
- Water Conservation Options

The screening process will compare a high-level, order-of-magnitude unit cost of the options to an index score of implementation risks created specifically for option screening. The intent would be to plot all of the options for these two parameters to see where outliers exist (meaning those options that have higher unit costs and higher implementation risks). The outlier options would be recommended for elimination from more detailed characterization.

1.3.2 Options Characterization Method

For options carried forward from screening to portfolio evaluation a summary characterization will be developed. Each of these options will be characterized using a standardized *Options Characterization Template* (including, for example, estimated yield and cost). The resulting set of characterized options will be used as a "menu" for forming thematic portfolios (for example, a portfolio that has "High Resiliency" as its theme, as described in more detail below). A list of the characterization metrics, associated units, and a metric definition are provided in **Table 2** for demand management options and **Table 3** for supply options. Option characterizations will be based on the best available technical information; however, more detailed analysis of these options will be required prior to implementation.

Table 3 Demand Management Options Characterization Template

Metric Name	Unit	Metric Definition
Average Annual Yield	AFY	The estimated average annual demand savings achievable by the measure
Supply Type	Qualitative Selection	Annual or emergency/drought
Unit-Cost	$/AF	Total annual cost of the measure for both the utility and the customer minus cost savings from reduced water production and wastewater treatment costs (in 2017 dollars) divided by the estimated average annual yield
Benefit Cost Ratio	Ratio	Average annual yield divided by the unit cost
Climate Resiliency	Qualitative Index	The relative susceptibility of an option to future hydrologic variability
Advantages	Qualitative Description	Narrative on positive attributes of option, including as it relates to portfolio evaluation sub-objectives
Disadvantages	Qualitative Description	Narrative on negative attributes of option, including as it relates to portfolio evaluation sub-objectives

Table 3 Supply Options Characterization Template

Metric Name	Unit	Metric Definition
Estimated Yield	AFY	The estimated incremental average annual new supply (or demand saving) to AW
Supply Type	Qualitative Selection	Annual or emergency/drought
Unit-Cost	$/AF	Total annual cost of the option (in current dollars) divided by the new supply yield. Cost will include both customer and utility perspectives and will include a high-level estimate of likelihood of use if designated as an emergency/drought-only supply
Climate Resiliency	Qualitative Index	The relative susceptibility of an option to future hydrologic variability
Advantages	Qualitative Description	Narrative on positive attributes of option, including as it relates to portfolio evaluation sub-objectives
Disadvantages	Qualitative Description	Narrative on negative attributes of option, including as it relates to portfolio evaluation sub-objectives

1.4 Portfolio Development and Evaluation

Options carried forward from screening and through characterization will be available for inclusion in IWRP portfolios. Water supply and demand-side options will be combined into portfolios that will meet supply needs under different hydrologic scenarios to various degrees of reliability.

Portfolios will be formed based on objective-based themes and then evaluated against the IWRP sub-objectives and performance measures. While the IWRP will produce analyses and demand/supply comparisons for the forecast years 2020, 2040, 2070, and 2115, portfolios will be compared and ranked using the planning year 2070. The selection of 2070 for the purposes of ranking portfolios was based on several factors, including: (1) it represents a long-term forecast that has more certainty than 2115, and (2) it aligns with the Texas Regional Water Planning process.

1.4.1 Method for Formulation of Portfolios

No single option can meet all of the stated IWRP objectives. Therefore, options are combined to form portfolios. The number of potential combinations of options (i.e. portfolios) is too large to produce a meaningful analysis for the AW IWRP. As a result, portfolios will be developed around major themes that align with the IWRP objectives. For example, what would a portfolio look like if the only objective is to maximize supply resiliency? Based on the options characterization results we can develop a portfolio whose sole focus is on supply resiliency and does not consider other objectives such as cost or environmental impact. By developing these initial portfolios that "push" the bounds of each of the most important objectives, trade-offs can be easily identified which can then provide insights in developing "hybrid" portfolios that are more balanced and have a better likelihood of meeting numerous objectives well.

Initial thematic portfolios will be developed by the AW/consultant team based on input from stakeholders, including the Water Forward Task Force. A list of example portfolio themes is provided below for illustration purposes only.

- **High Resiliency** – Options included in this portfolio are those that have little to no hydrologic variability (and therefore not subject to droughts or climate change)
- **Lower Cost** – Options included in this portfolio are those that have a lower unit cost ($/AF)
- **High Stewardship** – Options included in this portfolio are those such as conservation, water reuse, rainwater harvesting.
- **Maximize Local Control** – Options included in this portfolio are those in which AW has more control over terms of cost, yield, development, and operations in the future

- **Hybrid** – A hybrid portfolio will build on one or a combination of initial thematic portfolios to provide more balance and improved performance as it related to the IWRP sub-objectives

1.4.2 Portfolio Evaluation Method

When evaluating a diverse set of portfolios against multiple objectives it is not possible to find a single portfolio that meets the needs or priorities of every stakeholder. Instead, the goal is to evaluate trade-offs between options and objectives, which will be used make an informed decision on selecting a preferred portfolio. To do this, the AW IWRP will utilize multi-criteria decision analysis (MCDA) to evaluate portfolios. The MCDA process will rely on the performance measures and performance weights (outlined in previous sections) and a suite of tools. It is important to note that final recommendation will be "human-based," not computer model-based.

Overview of IWRP Tools

The software Criterium Decision Plus (CDP), developed by Infoharvest Inc., will be the primary software used to conduct MCDA; however, it will be dependent upon input from other IWRP tools and also input from stakeholders and subject matter experts. Each portfolio will undergo modeling and assessment that will generate raw quantitative and raw qualitative performance measure scores. **Figure 2** shows the portfolio evaluation workflow of IWRP tools. The below tools will serve a major role in development of performance measure scores for the AW IWRP:

- **Colorado Basin Water Availability Model (WAM)** – computer-based simulation model, developed and used by the Texas Commission on Environmental Quality (TCEQ) quantifying the amount of water that would be flowing in the Colorado River and available to water rights under a specified set of conditions (e.g. water use, naturalized hydrology, etc.)

- **Geospatial Decentralized Supply Suite of Tools** –set of geospatial analysis processes that evaluates the end user demands, supply yield, cost, and avoided costs associated with storm/gray/black water capture infrastructure

- **Disaggregated Demand Forecasting Model** – end-use based water demand forecast model including residential, multifamily, and commercial sectors; includes impacts of conservation (including Drought Contingency Plan implementation), weather and climate, and price of water.

- **Portfolio Evaluation Spreadsheet Tool** – spreadsheet tool utilized to assemble options into portfolios based on supply needs (difference between existing supplies and future demands under different hydrologic scenarios), and will estimate total portfolio costs from individual unit costs for each option.

- **Criterium Decision Plus** – an industry-leading commercial software to compare and rank portfolios based on multiple criteria (see below for detailed description).

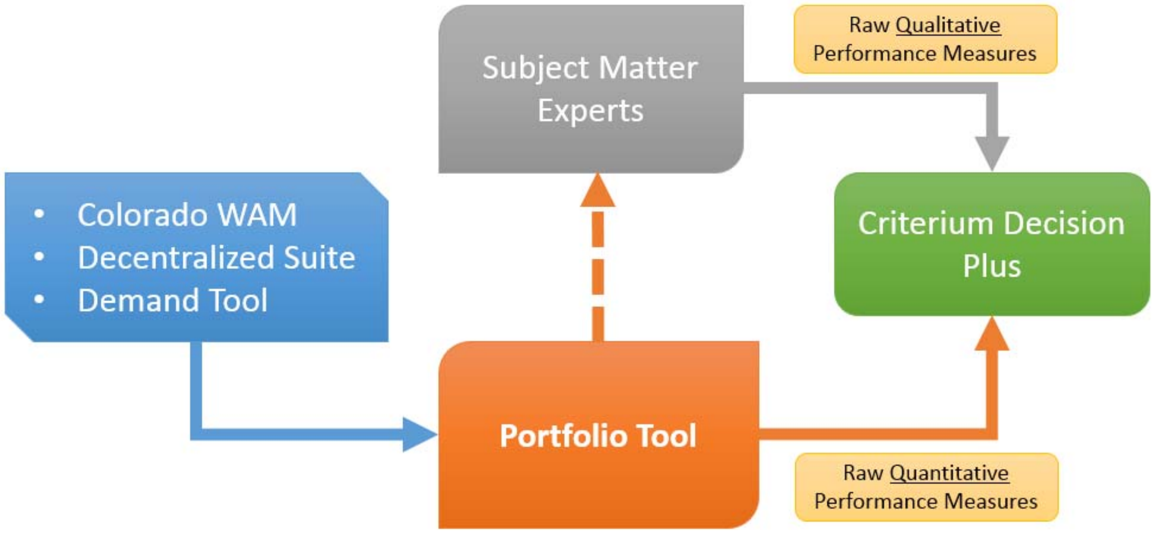

Figure 2 – IWRP Tool Portfolio Evaluation Workflow

Description of Water Availability Model Use in Portfolio Evaluation

In order to evaluate the robustness of the portfolio rankings, each portfolio will be evaluated and ranked under four hydrologic scenarios:

1. **Historic Hydrology**: based on the historical period of record from 1940 to 2016 maintaining the historical sequence of years.
2. **Extended Sampling of Historic Hydrology** : based on an extended 10,000 year simulation made up of resequenced years from the historic hydrology, this sequence is used to develop a range of conditions worse than the drought of 2007-2016
3. **Historic Hydrology with Climate Change Adjustments** : based on a climate change scenario ensemble that adjusts the historical hydrology, but maintains the historical sequence of years.
4. **Extended Sampling of Historic Hydrology with Climate Change Adjustments**: based on an extended 10,000 year simulation made up of resequenced years from the climate change-adjusted historic hydrology, this sequence is used to develop a range of conditions worse than the drought of 2007-2016

Additional detail related to each future climate condition will be established in future technical memorandums and in coordination with AW climate change and hydrology consultants. For each future hydrologic and climate condition new raw performance measure scores will be generated for each portfolio and entered into CDP for ranking. Not all performance measure scores will be impacted by a change in future climate conditions; however, sub-objectives such as Maximize Water Reliability, Minimize Life-cycle Unit Cost, and Minimize Ecosystem Impacts are likely to show some level of sensitivity. CDP will be utilized to efficiently develop portfolio rankings unique to each future hydrologic or climate condition. This analysis will establish whether or not a portfolio is robust as related to hydrologic and climate change uncertainty.

Description of Criterium Decision Plus Software

Criterium Decision Plus (CDP) will be used to rank portfolios. This software tool converts raw performance measured in different units into standardized scores so that the performance measures can be summarized into an overall value. Through CDP, a multi-attribute rating technique will be applied to score and rank the selected portfolios. One advantage of the multi-attribute rating technique is that the resulting scores are non-relative and thus not dependent on the number of portfolios. This allows for the addition of portfolios, such as hybrid portfolios, without impact to the scores of those portfolios previously evaluated. **Figure 3** summarizes the multi-attribute rating technique that is used by CDP to compare and rank portfolios.

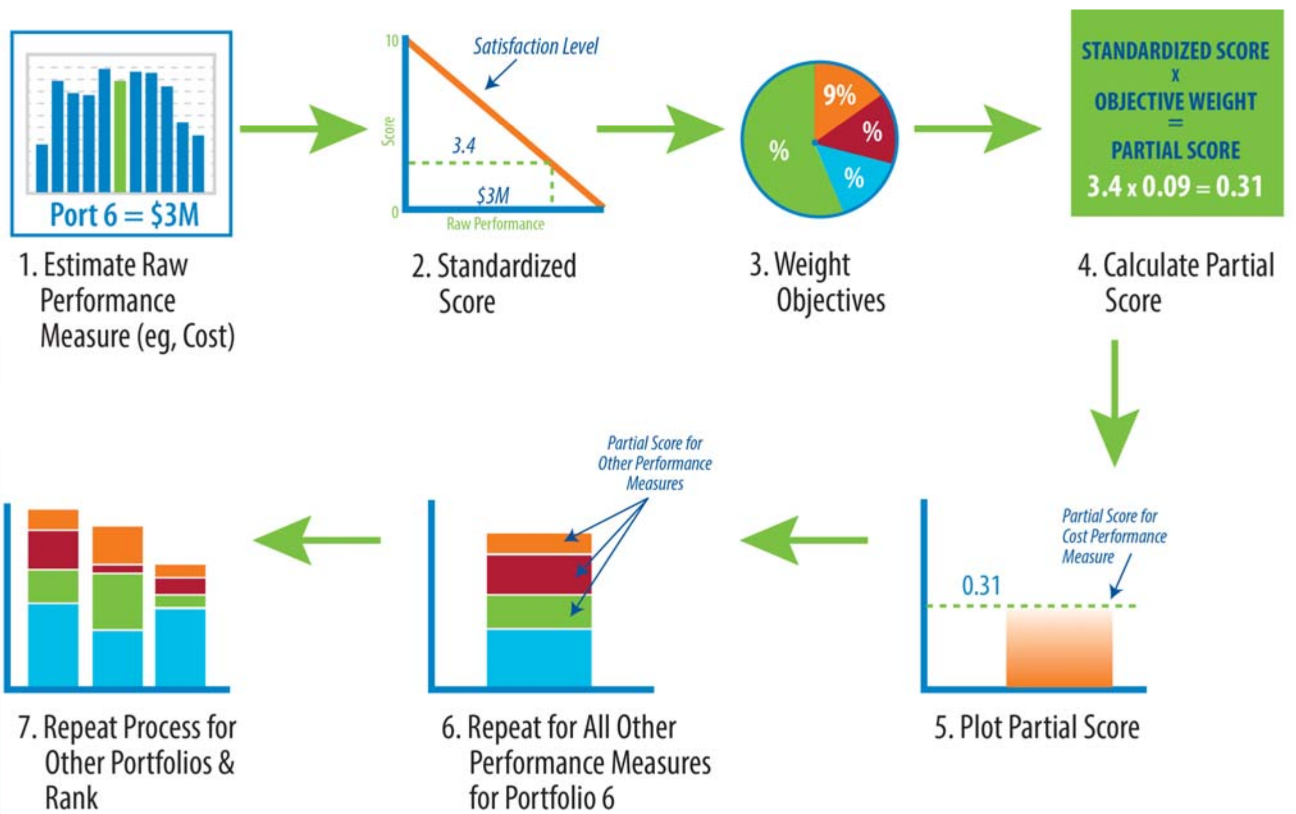

Figure 3 – Multi-Attribute Rating Technique Used by CDP Software to Rank Portfolios

Multi-attribute rating uses 7 steps to score and rank portfolios. In step 1, raw performance for all of the portfolios is compared for a given criterion (in this case cost). Step 2 standardizes the performance into a score from 0 to 10. In this example, Portfolio 6's cost performance is fairly expensive so its standardized score is fairly low (e.g., 3.4 out of 10). This step is important because performance is measured in different units (i.e., cost in dollars, reliability in AFY). Step 3 assigns weights to the objective and Step 4 calculates a partial score for a given portfolio based on the multiplication of the standardized score (Step 2) and weight (Step 3). The partial score is plotted (Step 5), and then the whole process is repeated for a given portfolio for all of the other performance measures (Step 6). This creates a total score that can then be compared to other portfolios. Steps 1-6 are repeated for all portfolios and compared so they can be ranked (Step 7).

Example of Portfolio Ranking

As outlined above, there are two primary inputs to CDP: (1) raw performance of a portfolio against each performance measure; and (2) the relative importance of the objectives and performance measures (see **Figure 4**).

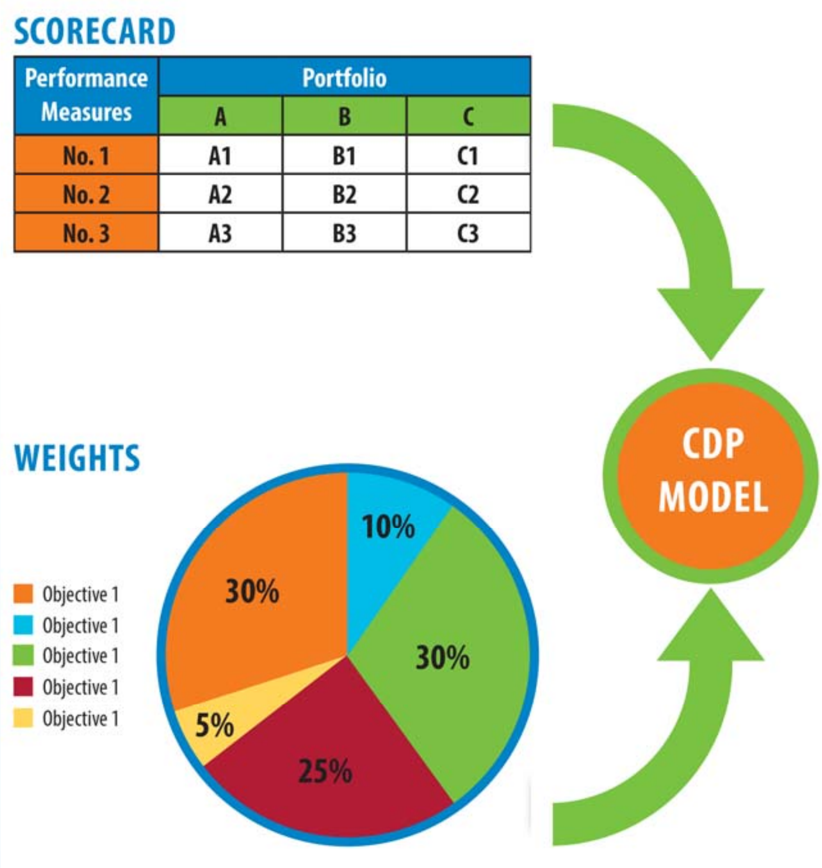

Figure 4 – Inputs to CDP

The raw performance measure scores will be standardized by CDP to a unitless scale that ranges from 0 to 1 using the multi-attribute rating technique (described above). The CDP model will then multiply the unitless performance scores by the relative weight of each associated sub-objective. These weighted unitless scores are then aggregated to the objective level and an overall portfolio score will be determined. This process is repeated for each portfolio and the portfolios are ranked based on their overall scores. **Figure 5** presents an example of how portfolios are ranked based on a set of primary objectives and their weights of importance. This process is powerful because it not only ranks portfolios but clearly shows trade-offs between the objectives.

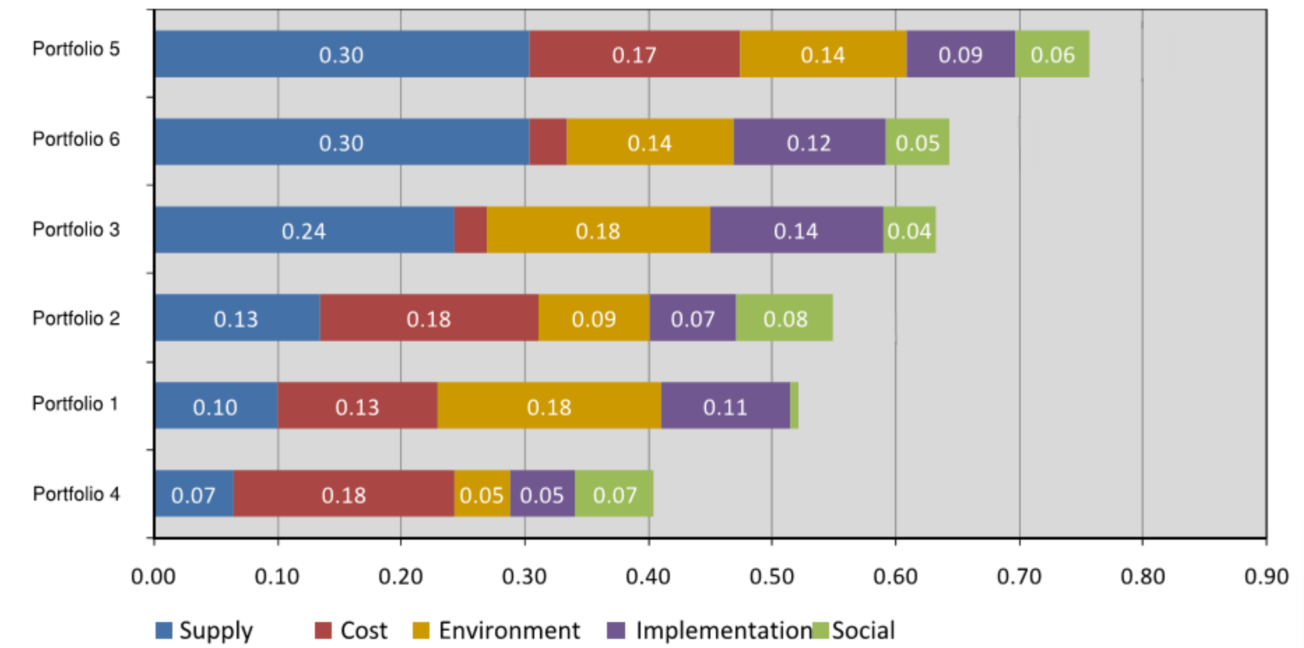

Figure 5 – Illustrative Example of Portfolio Ranking Using CDP Software

In this example of portfolio ranking, the larger the color bar segments the better the portfolio performs for a given objective. For example, Portfolio 5 has the best supply reliability and hence the longer bar segment for the supply objective. Portfolio 6 also has the best supply reliability score, but it is not as cost-effective (meaning it is higher in cost) than Portfolio 5 and hence it has a relatively small bar segment for the cost objective.

1.4.3 Sensitivity Analysis Method

An evaluation of the sensitivity of the portfolio rankings to the initial baseline objective weights will be performed. Several sensitivities will be conducted by altering the relative weights of the primary objectives. For example, in addition to the baseline weighting set, alternate weighting sets similar to the below list will be evaluated using CDP:

- All objectives are weighted equally, at 20 percent each
- Implementation Impacts are given a super weight of 40 percent, while all other objectives are given a weight of 15 percent each.
- Economics Impacts (or Cost) is given a super weight of 40 percent, while all other objectives are given a weight of 15 percent each

Table 3 indicates that example Portfolio 5 ranks 1st in three out of four weighting sets, and only when implementation is given a super weight does it rank 3rd. Example Portfolio 6, ranks 2nd in two out of four weighting sets and only ranks 1st when implementation is given a super weight. However, when cost is given a super weight example Portfolio 6 ranks 5th (second-to-last). All other portfolios never rank 1st and rarely are consistent in their ranking of 2nd and 3rd places. This sensitivity analysis indicates that the evaluation and ranking of portfolios is fairly robust.

Table 3 – Portfolio Ranking Sensitivity to Different Objective Weighting Sets

Weighting Set	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Portfolio 6
Baseline Weights	5	4	3	6	1	2
Equal Weights	6	3	4	5	1	2
Implementation Weight	5	4	2	6	3	1
Economic Weight	4	2	6	3	1	5
Average Ranking	**5.0**	**3.3**	**3.8**	**5.0**	**1.5**	**2.5**

The portfolio evaluation method provides a fair comparison of the portfolios through the use of CDP's multi-attribute rating technique combined with a sensitivity and uncertainty analysis. This approach will ensure that AW secures a diversified, sustainable, and resilient water future for the Austin community.