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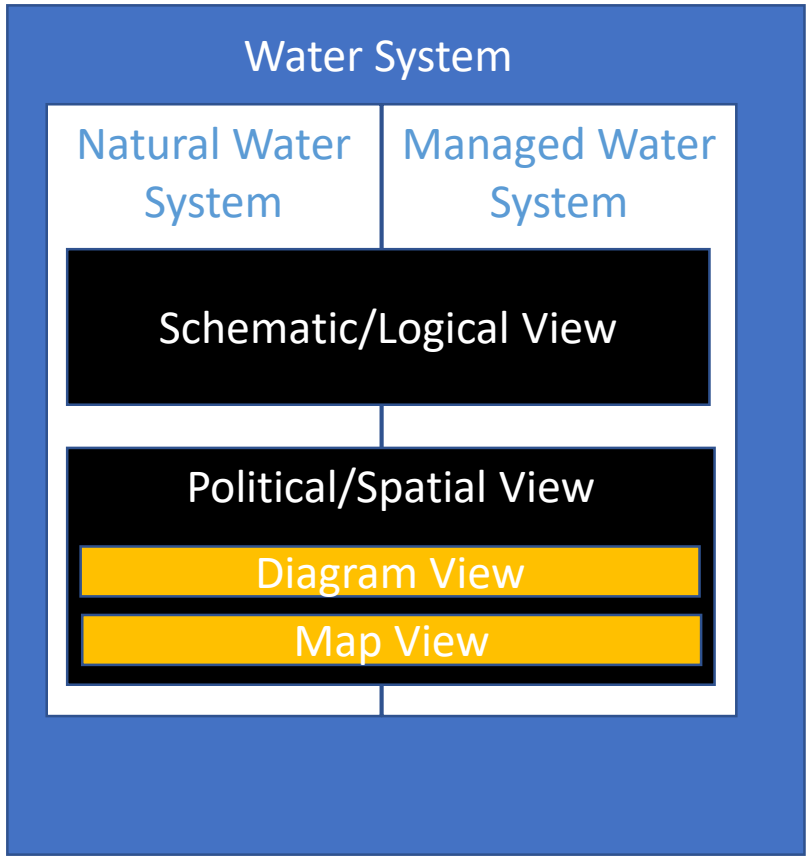
The "Water System"

Context, Scope and Terminology, and Implications to Water Conservation Goals

The “Water System”: Context and Scope



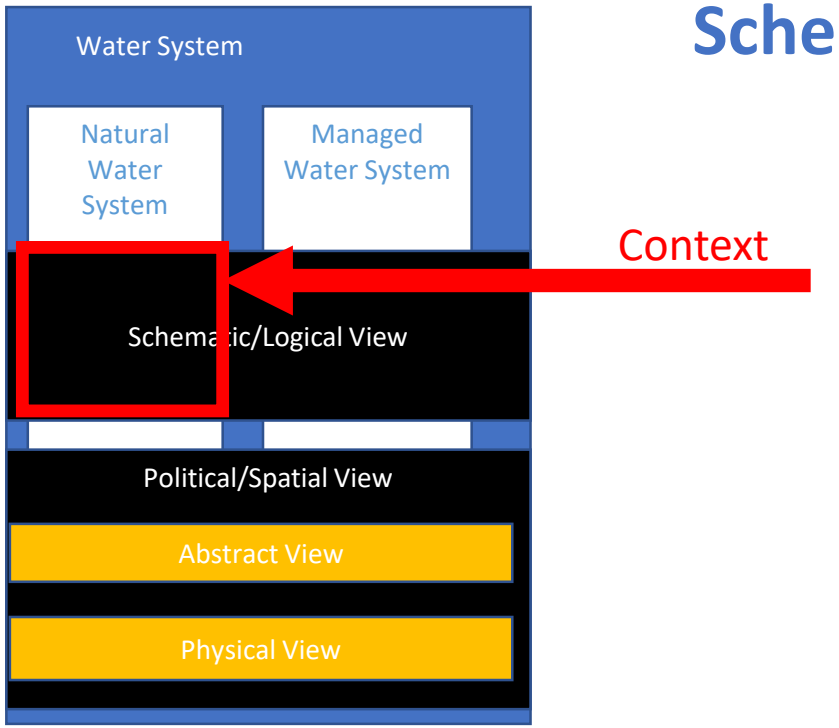
The purpose of this paper is to define the terms and relationships of “water” in order to properly define the context and scope of various elements and actions involved in the life of “water”. It may sound silly and superficial at first, and then overly complex later, or it may sound so abstract that it is useless. Be patient and see if there is value in describing the management of water.

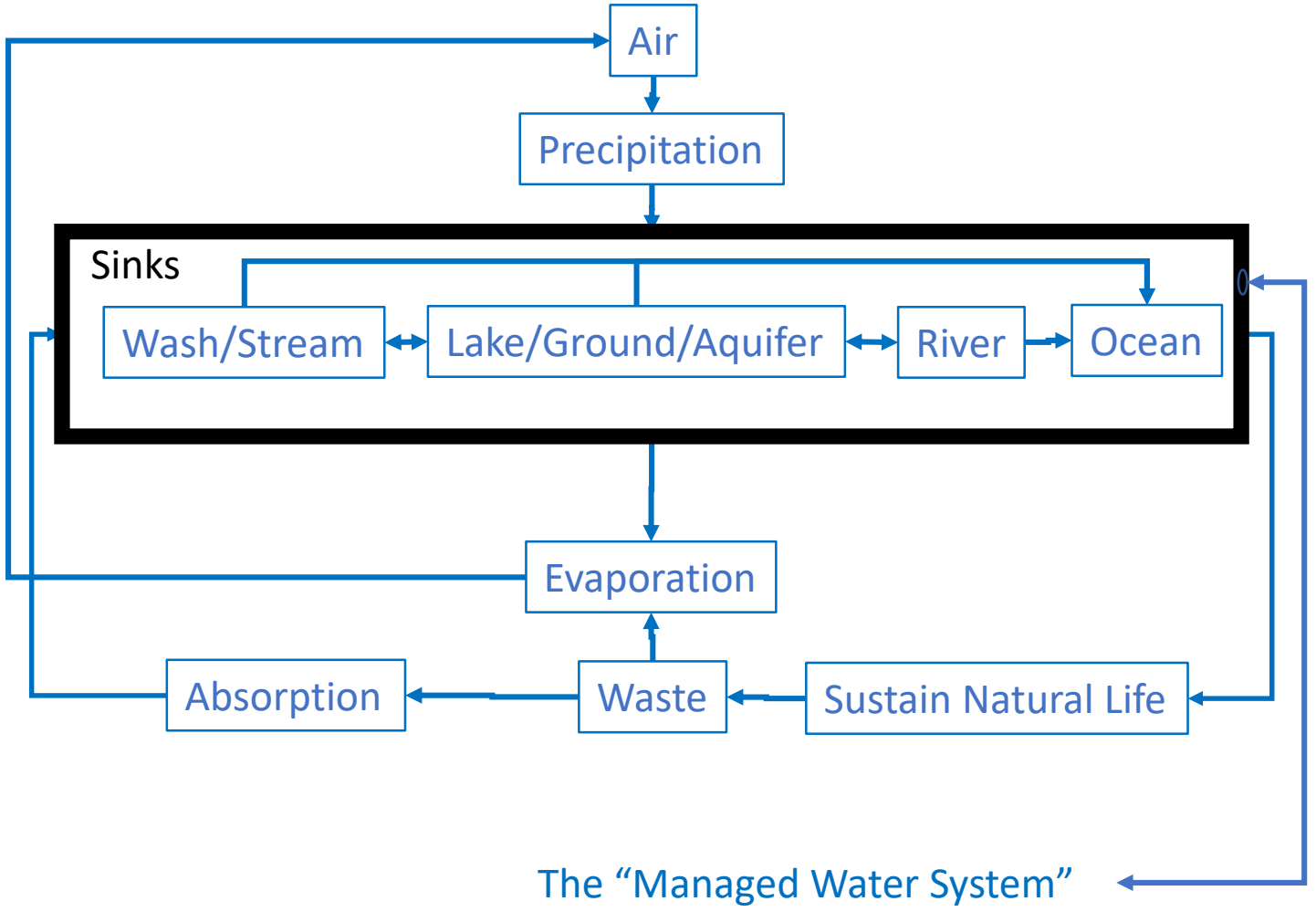
The Water System is composed of the Natural Water System, which is composed of the elements and actions that occur in nature, and the Managed Water System, which is composed of human-made elements and actions for the purpose of sustaining human life.

These systems can be defined and viewed in several perspectives:

- A schematic or logical view that names the elements, actions and relationships between them.
- A political/geographical view that describes the system relative to political and geographical boundaries. These can be described both in an abstract diagram and in a map.

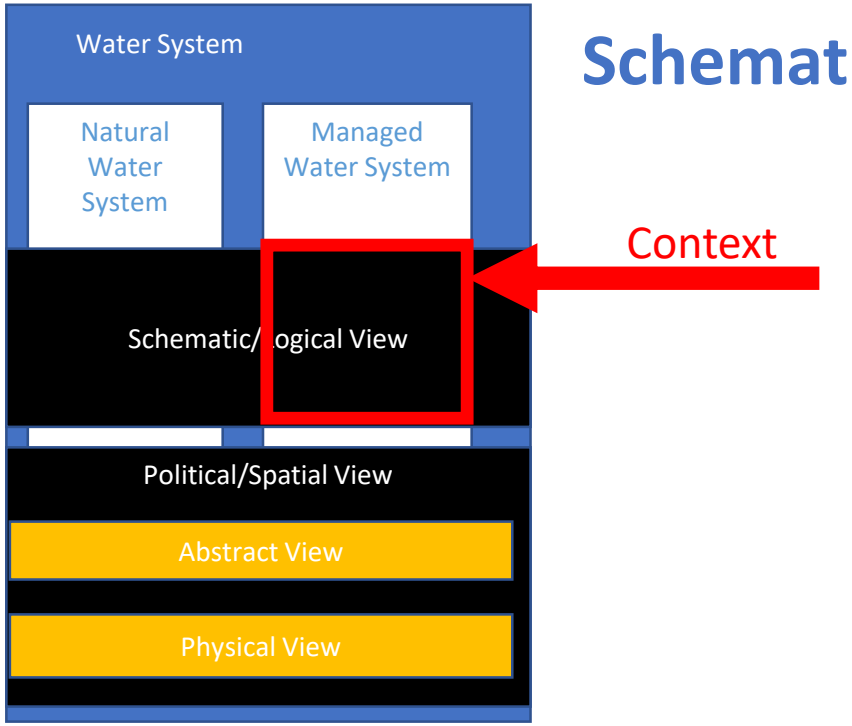
Schematic View of the Natural Water System



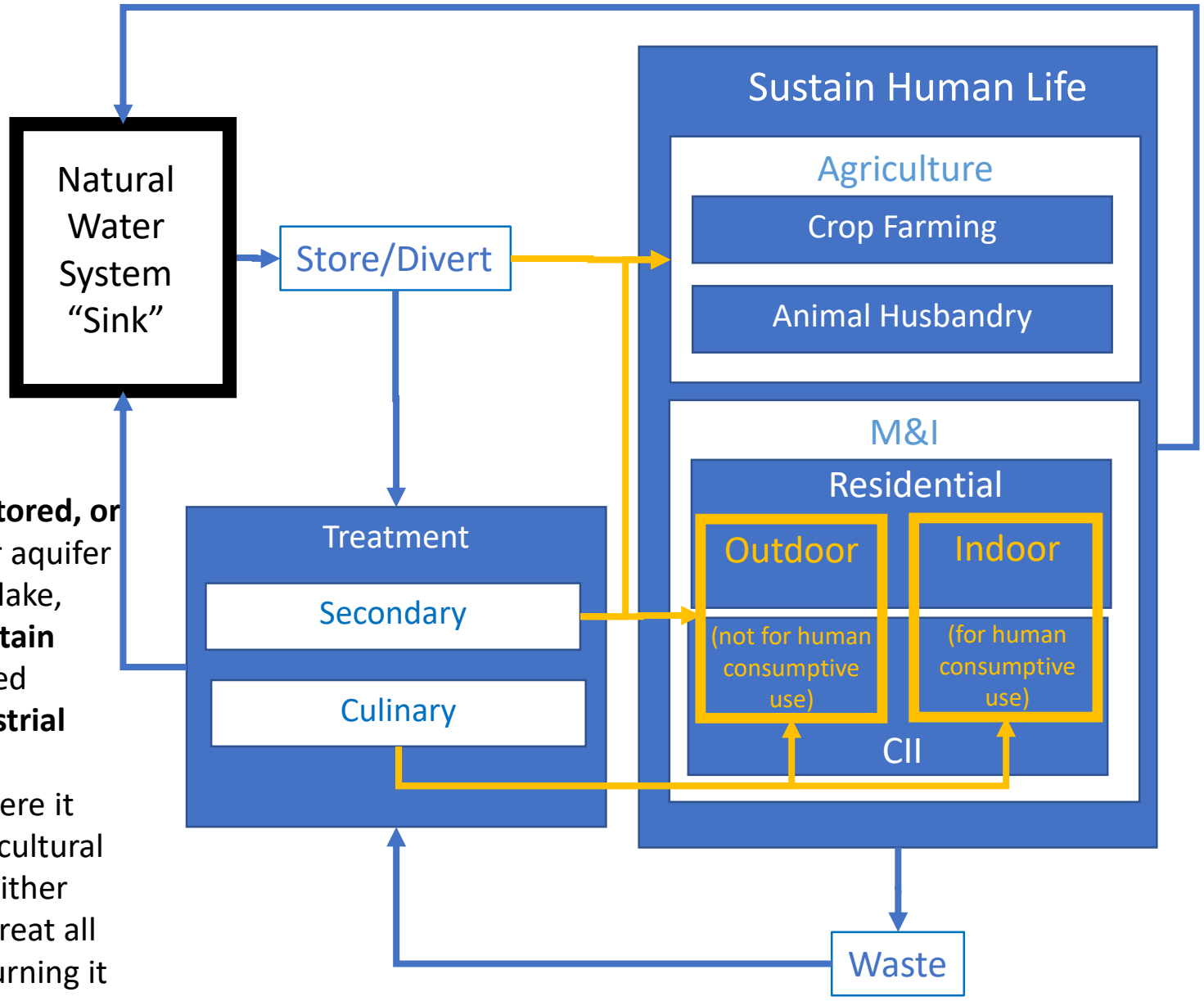


Bolded text denotes elements in the schematic: Water in the **air** (the "source") falls as **precipitation** into "**sinks**": **washes, streams, lakes, the ground, rivers and the ocean**. Most of it stays there, but a significant amount **evaporates** back into the **air**, and some of it is used to **sustain natural life** both plants and animals. Life sustenance produces "**waste** water" either through growth and maintenance processes or after life ceases, which is either absorbed back into the "sinks" or is evaporated back to the "source". All arrows are natural flows.

Schematic View of the Managed Water System



Context



Bolded text denotes elements in the schematic: Water **is stored, or directly diverted and then perhaps stored** in a reservoir or aquifer from a "**sink" in the Natural Water System** (wash, stream, lake, ground, river, ocean) to satisfy the demand required to **sustain human life**. For many water conditions, it can be safely used directly for **agricultural** purposes. For **Municipal and Industrial (M&I)** and certain agricultural purposes depending on the condition of the water, it is sent to a **treatment** facility, where it may be treated to an acceptable "**secondary**" level for agricultural and **outdoor M&I** uses or to a **culinary** level for M&I use, either only for **indoor** use or also for **outdoor** use. It is a goal to treat all **waste** water prior to reusing it to sustain human life or returning it to the **Natural Water System**, but some currently is not.

All arrow are "managed flows" using ditches, pipes, and pumps.

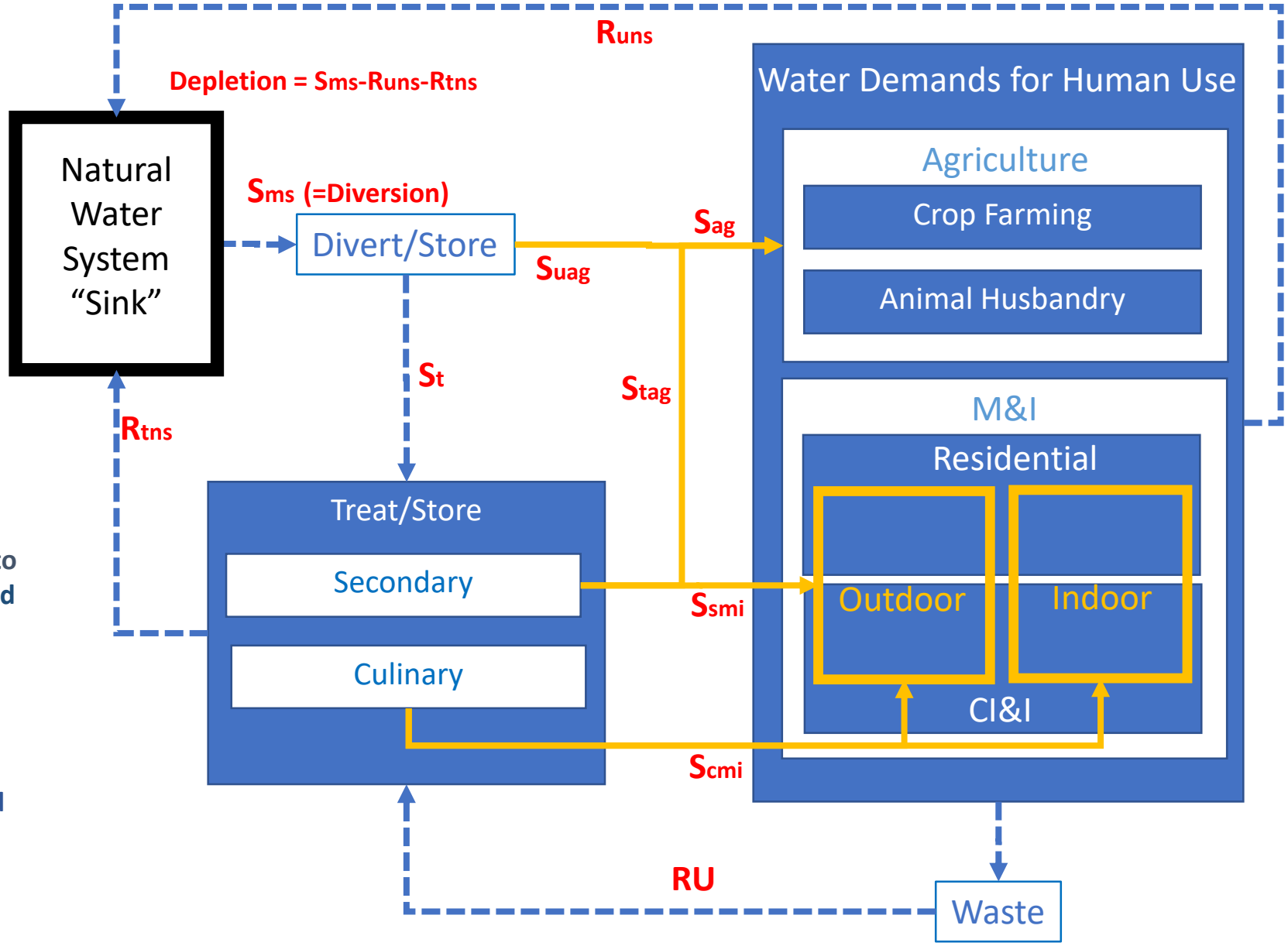
Managed Water System - Supply, Demand, Diversion, Depletion, Allocation and Conservation

Blue text below represents objects that are in the diagram.

Water is **diverted** from the Natural Water System to satisfy the **Water Demand for Human Use,** and is **stored** in various locations to enable immediate delivery when demand calls. The **solid gold arrows** in the diagram represent supply flows that satisfy immediate demand:

- **Agriculture Supply (Sag),** whether **untreated (Suag) or treated to some secondary level (Stag)**
- **Municipal & Industrial (M&I) Supply, whether treated to a culinary level (Scmi) or secondary level (Ssmi)**

Water Demand for Human Use in Utah is constrained by the amount of water that may be "depleted" from (i.e., not returned to) the **Natural Water System**. **Depletion = [Sms (= diversion) - water that is returned to the natural system], either untreated (Runs) or treated (Rtns).** The amount "return flow" may also be influenced by requirements to support the **Natural Water System** (endangered species) and may be location-specific. In Utah's constrained system, it is a goal to reduce depletion, certainly below its available supply*, which is be done by reducing **Water Demand for Human Use** (="conservation), increasing Re-Use **(RU),** and/or increasing the returns **(Rtns, Runs).** **Diversion- and Depletion-**related flows are shown in **dashed blue arrows.**



*Available supply = 23% of Colorado River Upper Basin allocation + precipitation outside the Colorado Watershed – requirements of the Natural Water System

Utah's "Managed Water System" Scope and Context: Observations and Conclusions

1. Key Elements of a Managed Water System

Supply must be defined, and must be defined in terms of probabilities, with only highly probable estimates used for management purposes.

Demand for the various types and uses of water must be managed and balanced, and held safety under the supply estimates. Net demand is the key element to be managed, which in turn drives management of diversion, depletion, return, re-use and gross demand for the various types and uses of water, and the balancing of them.

2. Water Requirements, Goals and Objectives

Utah must define requirements, goals and objectives in order to set the parameters for managing its water system. **They have not yet be defined**:

Requirements define the condition that must be met.

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Goals define a target condition that is to be met at some future point, often not precisely defined; "and end at which effort is directed". In "planning" processes, goals are defined in a program plan and are not precise in specifying a specific value or time.

Objectives define a condition that is to be met at a specific time. In planning processes, overall objectives may be defined in a program plan; however, specific objectives must be defined in each project plan, specifying what the project must achieve.

For Utah's Managed Water System,

The requirement: net demand must be less than the supply.

Goal-setting requires some real thinking. They should be set in two directions, covering goals constrained by what could actually be supplied and, more difficult, by how demand should be shaped. For example:

Supply-constrained: the 90% high probability net demand must be 10% lower than the 90% high probability supply.

Demand-constrained: maximize state GDP and the happiness of its residents. This would then have to be detailed and the ramifications for water defined.

The program objective would define specific net demand (in acre-feet yearly) at specific years.

Project objectives would be more granular.

Utah's "Managed Water System" Scope and Context: Observations and Conclusions

3. Planning

Utah should define, plan and manage programs at the state and regional/local levels for the purpose of managing its water system. Industry standard program management processes should be used. Currently both the guidance from the state and the implementation by cities and water districts is severely lacking.

4. Demand Balancing to Reduce Net Demand

Net demand can potentially be reduced by changing and appropriately balancing the internal demands for agriculture and M&I water, and internal to M&I, residential, CII, culinary, secondary, reuse and return water. This balancing is driven by requirements, and the goals and objectives for those categories of water use. It could be determined that it is not appropriate to deplete 70% of the state's (or a region's) allocated water supply on agriculture, or that it is not appropriate to use 60% of the culinary water on outdoor uses. Adjusting these internal demands could reduce net demand.

5. Implications to Utah's M&I Water Conservation Goals

1. The definition of "water conservation" is not clear. Is it addressing net or gross demand? From the perspective of normal language definitions and from the report's contents, it appears to address gross demand. This seems to be an incorrect scope since it is net demand that matters. This would imply that water re-use should be in the scope of the report. The target of the report should be to set "net water demand" goals, not "water conservation goals".
2. The goals defined are specific for regions at a specific time. This may be appropriate, but it is at best incomplete and perhaps inappropriate. The goals are stated in terms of "objectives", which may be ok if the over-arching goals were also defined, but there is no evidence of that. Defining the higher level goals requires the context of the state's goals that drive the use of water. Without that context, it's impossible to judge the appropriateness of the water demand goal. The surveys and open houses provided some materials from which these higher-order goals could be derived. This step must be explicitly done.
3. The goals must be defined with respect to requirements and supply and demand constraints. This was not done.
4. M&I is of course only a part of Utah's water use, with agriculture using most of it. Since demand should be properly balanced between M&I and agriculture, setting goals for one without respect to the other gives an unbalanced goal. This must be addressed.

References:

1. A simple, easily adjusted, model to estimate Utah's water supply
2. https://conserveswu.org/wp-content/uploads/The-Nature-of-Water-Conservation-Planning.docx