Appendix C

Demand for and Value of Beneficial Uses of Water

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The overall value of water is derived from the values associated with the services water and related land resources are expected to provide over time. These services can include any outcome that contributes to a generally accepted measure of human welfare.

Demand

Demand is typically defined as the quantity of a good or service that may be purchased or utilized at varying prices. Fundamentally, demand is driven by the tastes and preferences of the consumer.

All public goods, water among them, are complex and highly integrated resources. It is often impossible to utilize one service or group of services without affecting other goods or services.

Services & Benefits Provided

Because public goods and services are integrated and often provide a collective or common benefit, the problem of demand and valuation is approached by separating the demand for water and related resources into direct and indirect demand. We have also framed the beneficial uses in terms of services provided to the public.

Directly Demanded Services

Direct demand involves the use of water and related land resources in a manner that they are consumed or used directly:

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Indirectly Demanded Services

Indirect demand is the demand for the benefits derived from the indirect use of water. Water is not directly consumed. After utilization the quantity of water remains for additional use.

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For the purposes of assessing the demand for and value of the direct and indirect services provided by water within the Coon Creek Watershed, it is important to note that:

1. All watersheds, regardless of their size and complexity, provide some beneficial uses

2. Different watersheds in different landscape contexts can provide very different mixes of beneficial uses.
3. Beneficial uses, when they are provided in different locations, may not be equally scarce, suitable or replaceable, and may be more or less accessible to people who value them.

Definitions

Functions, services, values, risk and several other terms are used in different ways in the assessment literature and in the economics literature. The following definitions are offered to minimize confusion over what will be used in the following sections as building blocks for determining the demand fort and value of the beneficial uses of water.

Features On-site characteristics of a water or related resource that establishes the capacity to perform or support various functions (soil, geology, slope, ground cover)

Functions The biogeochemical processes that take place within a given water or related resource. The level of function depends on site and landscape characteristics and can be assessed independent of human context.

The following biogeochemical processes occur within the Coon Creek Watershed which influence the type and extent of benefits provided by the watershed:

- Conveyance of Water (Stream flow, groundwater recharge, infiltration)
- Storage of Surface Water (lakes, wetlands, ponds)
- Storage of Groundwater
- Dissipation of water (Evapotranspiration loss)

As the Watershed has developed over the last 30 years the degree to which these functions can occur has changed and in some cases been diminished to the point that in some areas of the watershed they cease to function. Groundwater storage and stream flow are two examples.

Landscape Context Proximity of the resource to other natural or man-made features in the surrounding landscape. Landscape context influences the opportunity of a resource to function at capacity, the services that will flow from those functions, the value of those services, and the risk that the services will not persist.

Relative Preferences The rank or uses, services and benefits in order of importance. Relative preferences for various uses and services are much easier to determine than differences in dollar value measures of service

values. Although less common than dollar measures of value, individual and community ranked preferences can be used to aggregate service values and compare resource uses using a single measure.

Risk The volatility of potential outcomes. In the case of water and related resource values, the important risk factors are those that

1. Affect the possibility of service flow disruption
2. The reversibility of service flow disruptions

These are associated with controllable and uncontrollable on-site risk factors (eg. Invasive plants, over appropriation, mitigation failure such as stormwater features that no longer work properly) and landscape risk factors (eg. Changes in land use or climate)

Services The beneficial outcomes that result from biogeochemical functions (potable water, fishable and swimmable lakes, flow regimes that do not damage property of flood fields)

These require some interaction with, or at least some appreciation by, humans. However, they can be measured in physical terms (water quality measures, increased catch rates or visitor days, property damages avoided). The capacity of a resource to provide services can be estimated without any ethical or subjective judgments about how much the services are worth. The types of potential services depend to some degree on the level of functions but predominantly on other factors (eg. Access, proximity to people, position in the watershed).

Values Defined in strict economic terms, the full range of water resource values includes each person's "willingness-to-pay" in dollars for each service summed across all people and all services. In most cases, tracing or estimating the absolute (dollar) value of water and all related resources is impossible. However, overall willingness to pay for a service depends on:

- The number of people with access
- Their income and tastes
- The cost of access
- The availability of substitutes
- Other factors related to local, regional and national supply and demand

Approach

The District's approach to assessing demand and value relies heavily on available public data to expand indices of ecological and hydrologic function to reflect human services and values. It is intended as a toll for comparing and contrasting services and

benefits based on accepted economic principles. For a complete review of the economic background and approaches to valuation see King, D.M., et al. 2000. Expanding Wetland Assessment Procedures: Linking Indices of Wetland Function with Services and Values. USACE ERDC/EL TR-00-17.

The approach adopted employ a two tier system that considers both:

1. Relative value of a service or beneficial use (Expected Service Value at different locations) and
2. Relative preferences that people have for different services.

The analysis and discussion on demand and value for each beneficial use will involve an assessment of 10 factors:

1. Level of Function Is an assessment of the biogeochemical condition and landscape context of the processes or factors required to provide a given use or benefit.

2. Service Capacity Is an assessment of the quantity and quality of the services or beneficial uses expected per unit of function.

3. Level of Service An assessment of how well an area is functioning relative to the biogeochemical processes that support a service and an area's service capacity.

The level of service (provision of a beneficial uses, specific benefits and services) reflects the level and type of biogeochemical functions and any other off-site characteristics that either limit or enhance the ability to provide the chosen service. It is in essence a product of the level of function and the service capacity

4. Value of Service The necessary factors and conditions that affect aggregate demand for a service within the Coon Creek Watershed.

The initial value is based on the expected value per unit of service and is used to modify the level of service.

5. Risk to Service Involves an assessment of the exposure and vulnerability of the water and related resource functions for a given time period

Risks of disruptions to services differ from site to site and are associated with the exposure and vulnerability of the drainage system itself and the vulnerability and exposure of important

	landscape features that affect the functional capacity of the system. Threats that cause risk can arise from physical, social or managerial actions or processes.
6. Expected Service Level	Is the product of assessing the value of a given benefit, use or service and the risks to that benefit, use or service.
7. Service Preferences	Reflects the preferences expressed in a survey of citizens, City Engineers and water resource professional conducted in April and May of 2011.
8. Adjusted Service Value	Shows the relative value of the benefit, use or service relative to other benefits, uses or services
9. Overall Value	Discusses the value of all of the benefits, uses and services over all time periods

Beneficial Uses

"Beneficial uses" are the uses that water and related land resources provide for people. The U.S. Environmental Protection Agency (EPA), which administers the Clean Water Act, uses a related term "designated uses." Seven beneficial uses are defined in Minn. Rule. 7050.0140.

Five 'Beneficial Uses' occur within the Coon Creek Watershed. Those uses are

1. Domestic Consumption
2. Aquatic Life And Recreation
3. Industrial Consumption
4. Agriculture And Wildlife
5. Aesthetic Enjoyment And Navigation
6. Other Uses And Protection of Border Waters
7. Limited Resource Value Waters

Drinking water — **Class 1 waters, domestic consumption**.

Domestic consumption includes all waters of the state that are or may be used as a source of supply for drinking, culinary or food processing use, or other domestic purposes and for which quality control is or may be necessary to protect the public health, safety, or welfare

Aquatic life and recreation — **Class 2 waters, aquatic life and recreation**.

Aquatic life and recreation includes all waters of the state that support or may support fish, other aquatic life, bathing, boating, or other recreational purposes and for which quality control is or may be necessary to protect aquatic or terrestrial life or their habitats or the public health, safety, or welfare.

Industrial Use **Class 3 waters, industrial consumption**.

Industrial consumption includes all waters of the state that are or may be used as a source of supply for industrial process or cooling water, or any other industrial or commercial purposes, and for which quality control is or may be necessary to protect the public health, safety, or welfare.

Irrigation **Class 4 waters, agriculture and wildlife**.

Class 4A - Irrigation
Class 4B - Livestock and wildlife watering

Agriculture and wildlife includes all waters of the state that are or may be used for any agricultural purposes, including stock watering and irrigation, or by waterfowl or other wildlife and for which quality control is or may be necessary to protect terrestrial life and its habitat or the public health, safety, or welfare.

Aesthetics **Class 5 waters, aesthetic enjoyment and navigation**

Aesthetic enjoyment and navigation includes all waters of the state that are or may be used for any form of water transportation or navigation or fire prevention and for which quality control is or may be necessary to protect the public health, safety, or welfare

Other Uses **Class 6 waters, other uses and protection of border waters**.

Other uses includes all waters of the state that serve or may serve the uses in subparts 2 to 6 or any other beneficial uses not listed in this part, including without limitation any such uses in this or any other state, province, or nation of any waters flowing through or originating in this state, and for which quality control is or may be necessary for the declared purposes in this part, to conform with the requirements of the legally constituted state or national agencies having jurisdiction over such waters, or for any other considerations the agency may deem proper

Limited Resource Value Waters **Class 7 waters, limited resource value waters**.

Limited resource value waters include surface waters of the state that have been subject to a use attainability analysis and have been found to have limited value as a water resource.

Water quantities in these waters are intermittent or less than one cubic foot per second at the 7Q10 flow as defined in part 7050.0130, subpart 3.

These waters shall be protected so as to allow secondary body contact use, to preserve the groundwater for use as a potable water supply, and to protect aesthetic qualities of the water.

It is the intent of the MPCA that very few waters be classified as limited resource value waters. The use attainability analysis must take into consideration those factors listed in Minnesota Statutes, section 115.44, subdivisions 2 and 3. The agency, in cooperation and agreement with the Department of Natural Resources with respect to determination of fisheries values and potential, shall use this information to determine the extent to which the waters of the state demonstrate that:

A. The existing and potential faunal and floral communities are severely limited by natural conditions as exhibited by poor water quality characteristics, lack of habitat, or lack of water;
B. The quality of the resource has been significantly altered by human activity and the effect is essentially irreversible; or
C. There are limited recreational opportunities, such as fishing, swimming, wading, or boating, in and on the water resource.

The conditions in items A and C or B and C must be established by the use attainability analysis before the waters can be classified as limited resource value waters

Ground Water All groundwater is protected for just one use, as an actual or potential source of drinking water. All ground water is designated as Class 1

Surface Water All surface waters, lakes, rivers, streams and wetlands, in Minnesota are protected for multiple uses. The vast majority of surface waters are designated as Class 2; that is, they are protected for aquatic life and recreation.

Class 2 waters (i.e., all surface waters) are also protected for industrial use (Class 3), agricultural uses (Class 4A and 4B), aesthetics and navigation (Class 5), and other uses (Class 6).

In addition, some surface waters are protected as a source of drinking water (Class 1). An example of Class 1 waters include

portions of the Mississippi River upstream of St. Anthony Falls,

This classification is consistent with the Clean Water Act goal that all waters should have "quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides recreation in and on the water," wherever attainable.

People's Preferences

Reflects the preferences expressed in a survey of citizens, city engineers and water resource professional conducted in April and May of 2011.

In April and May 2011 29 citizens, engineers from the seven cities within the watersh and water resource professionals who are members of the 'planning advisory commit were administered a paired comparison survey of the beneficial uses of and the dema on water resources.

Rank Ordered Preferences for Beneficial Uses of Water within Coon Creek Watershed

Beneficial Use of Water	**Citizens**	**City Engineers**	**Water Professionals**	**National**
Drinking water	1	1	1	1
Water Quality	2	2	2	2
Flood Control	2	2	3	5
Groundwater Recharge	4	4	4	7
Storm Protection	6	5	6	6
Drainage	5	8	7	8
Aquatic life and recreation	8	8	5	9
Hunting and Fishing	**8**	**8**	**9**	**10**
Irrigation	9	9	10	4
Livestock and wildlife watering	10	10	8	11
Aesthetics	**11**	**11**	**11**	**12**
Industrial use and cooling	13	13	12	3

Demand Summary

Demand	Measure	Projected Change in Demand 2010-2020
Water Quality	Impairments	300%
Wildlife	E&T & Invasive spp	42%
Land	Res, Comm & Indust	22%
Aesthetics & Recreation	Population	10%
Flood Control	Acres	10%
Drinking Water	MGD	4%
Irrigation	MGD	-16%
Drainage	Acres of Ag Land	-17%
Groundwater Recharge		