For both environmental and economic reasons, managing water consumption and finding ways to reduce water waste is an important initiative for distilleries and breweries. Developing a water balance will give a facility a thorough picture of overall water use at the location. It is often appropriate to develop a water balance when a facility is beginning water efficiency efforts or during a detailed water audit.

A water balance is an assessment of the water entering and leaving a facility. It provides an understanding of water use and can help identify opportunities for improving water efficiency and reducing costs. A water balance typically includes all water input(s) and all flows out of the facility, including product water, wastewater and other water wastes.

The Basics
A water balance is a diagram, spreadsheet, chart, or table of a facility's water use that shows the flows of water into and out of the facility and typically uses the basic calculation shown below:

```
Input (A)  ➔  Process Unit  ➔  Output (C)

Water Losses (B)
```

A. Input from Water Source
B. Water Losses (e.g. to air, land, etc.)
C. Output (e.g. wastewater, product, etc.)

The difference is the amount of water unaccounted for or lost. Water may be lost within the facility to the air through evaporation, or to the land as a result of leaks or spills.

Outside expertise can help develop a water balance. Some local water utilities may provide this service.

The true cost of water can be up to three times the billed cost of water.

Need Help...
- establishing lean practices,
- training a team,
- or educating employees about resource efficiency?

Contact the Kentucky Pollution Prevention Center!

Website: www.kppc.org
Email: info@kppc.org
Phone: 502-852-0965
Before You Start

A water balance can be created for an entire facility or a single process. Before starting, decide on the scope and format of the desired water balance. For simplicity, this document will focus on creating a facility wide water balance in the form of a diagram. However, the concepts presented can be applied to creating a process specific water balance. The data from the water balance can be entered into a spreadsheet, table or chart. Below is a list of information that will be needed to create a water balance:

- Sources of incoming water
- Prior water and sewer bills
- Number and locations of water meters
- Product water for the same timeframe as the water/sewer bills
- Information about wastewater discharges
- Other known water discharges such as stillage

Getting Started

The first step in developing a water balance is to evaluate and quantify the amount of water entering and exiting the facility. The following are ways this can be done.

- **Facility Walk-Though** - During a walk-through draw out how water is use throughout the whole facility and grounds. Make sure to identify where water enters/exists and is being used. Start with areas that consume large amounts of water. Also ask operators questions about how water is used and the volume consumed. Do not overlook domestic water use in bathrooms, kitchen facilities, breakrooms and onsite bars/restaurants, heating/cooling and landscaping.

- **Water Bill Analysis** - Review the water and sewer billing information to confirm the volume of water and wastewater the facility is billed for. Some utilities will assume that the wastewater is equal to the water that is consumed and bill for wastewater accordingly. This assumption may be good for some, but not good for facilities where product water and water loss is significant. If wastewater volume is not included in the billing information, it may be obtained from engineering or wastewater quality testing reports.

- **Facility Outflows** - View production records to identify the amount of water leaving the facility as product. Convert all production data to volumetric gallons (i.e. not proof gallons). This volumetric measure will be an estimate of the water leaving the facility in the product. Water may also be leaving the facility through waste that is not sent to sewer systems (i.e. stillage or spent grains). Determine the volume of this waste and the percentage of water or moisture content. With this information, calculate the volume of water leaving the facility through this waste.
Drafting the Diagram

Once all the data is collected, a water balance diagram can be created on a monthly or annual basis. The data can be entered into a spreadsheet and plotted to visualize trends. Make sure to note all water use on the diagram by tracking water flows from the source through all operations at the facility to water losses/outputs. Continue working left to right by identifying the amount of water used for each process and place that in the box representing that process step. Remember to include water added to the product (i.e. goods created) and water used for other processes including cleaning. One should be able to track water as it flows from the source through all facility operations until the water finally leaves the facility using the drafted diagram.

Calculating Water Losses

Using this information, it is possible to calculate water losses (a.k.a. water balance). The sum of wastewater, water in the stillage, water used in the product, and water losses equals the source water entering the facility. Water losses can be calculated using the following formula:

\[ I - (W + S + G) = L_E + L_U \]

- \( I \) = Inflow Water
- \( W \) = Wastewater
- \( S \) = Water in Stillage
- \( G \) = Water in Goods Created
- \( L_E \) = Water loss due to evaporation
- \( L_U \) = Water loss due to unknown causes

Figure 2. Simplified Water Balance Example with Subsystems
**Improvement Strategies**

The facility water balance is a powerful tool for identifying, evaluating, and prioritizing water efficiency improvements. As you review the drafted water balance, ask the following questions to identify opportunities to improve water efficiency at the facility:

- Can we stop or prevent losses (e.g. leaks)?
- Can we reduce water use (e.g. changing equipment, plumbing, processes and/or behaviors)?
- Can we recycle or reuse water for another purpose (e.g. recirculating water within a process, reusing process water for another application, capturing rainwater, etc.)?

Based on the answers from the questions above, there are five general types of water saving strategies that a facility can employ:

- Adjust the water flow
- Modify existing/adapt equipment
- Install water savings devices
- Reuse/recycle water
- Shift to low water or waterless processes

A water balance also helps a facility establish a baseline, from which improvements in efficiency can be evaluated.

**Implementing Change**

When implementing water efficiency improvements, consider the impacts of the action(s) on other process improvements or performance goals. Select best management practices and technologies that make sense for the facility. To assist employees with the changes, adopt visual controls, “mistake proof” devices on equipment and/or procedures. Also develop or update the standard work for the activity so that workers can easily identify the best way to perform an activity. Also make sure to internally recognize the contributions of teams and individuals. External recognition from a third party will provide additional validation to a facility’s water efficiency endeavors and enhance the company’s public image.

**Additional Resources**

**U.S. Environmental Protection Agency**

*Lean and Water Toolkit*  

**Brewers Association**

*Water and Wastewater Sustainability Manual*  

**Kentucky Pollution Prevention Center**

*Sustainable Spirits and Brewing Initiative*  
[http://kppc.org/ksmi/ssb/](http://kppc.org/ksmi/ssb/)  
info@kppc.org  
502-852-0965

**Kentucky Division of Compliance Assistance**

*Kentucky’s Sustainable Spirits Initiative*  
[https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/Pages/sustainable-spirits.aspx](https://eec.ky.gov/Environmental-Protection/Compliance-Assistance/Pages/sustainable-spirits.aspx)  
enhelp@ky.gov  
502-782-6189

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**Recognition Opportunity...**

Kentucky Excellence in Environmental Leadership (KY EXCEL) is a program that recognizes environmental achievements throughout Kentucky.

For details, contact **KY EXCEL!**

*Email*: envhelp@ky.gov  
*Phone*: 502-782-6189

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**Kentucky Division of Compliance Assistance**

Produced by the Kentucky Pollution Prevention Partnership (KP3) thanks to US EPA Pollution Prevention Grant Funding
# Water Use Assessments

Organize a facility walk-through using the checklist below to assess water use and find water saving opportunities. Assessments are powerful tools for involving facilities and encouraging buy-in.

## Process and Equipment Use
- Cleaning, Rinsing, Washing
- Process Water Reuse
- RO Water Process
- Water Pumps
- Water Use in Products

## Heating and Cooling
- Cooling Towers
- Boilers, Hot Water, Steam Systems

## Other Facilities
- Toilets and Urinals
- Faucets and Wash-up Basins
- Floor Cleaning/Mopping
- Laboratories
- Landscaping and Irrigation

## Kitchens and Breakrooms
- Dishwashers
- Faucets and Sinks
- Ice Machines
- Food Disposals
- Water Use in Products

NOTE: Facility walk-throughs are also hands-on learning opportunities because team members may see best practices in action. After an assessment, an in-depth report should be written and a summary circulated internally.
Mapping for Sustainability

Creating a Sustainable Value Stream Map can help a company identify ways to increase the sustainability of their manufacturing process(es). Below is an example of such a map.

### PROCESS FLOW DIAGRAM

**Supplier**
- Grain Handling: 6.89 bushels, 2 hr.
- Mash Cooking: 8,000 gal., 7 hr., 4 hr.
- Fermentation: 13,000 gallons, 2 hr., 2 hr.
- Distillation: 8 hr., 1,620 gallons
- Aging: 4-6 years

**Customer**
- Spirits Gauging: 1,620 gallons, 4 hr.
- Processing: 100 gal., 4 hr.

**LEGEND**
- Gasoline
- Water Consumed
- Process Time
- Equipment Use Time
- Cooling Water
- Chilled Water
- RO Water
- Steam
- Electric Demand
- Electric Usage

**Mapping Details**

- **Water Consumed**
  - Supplier: 0.50 gal., 2 hr.
  - Customer: 1.62 gal.

- **Grain**
  - Supplier: 6.89 bushels
  - Customer: 0.25 gal.

- **Process Time**
  - Supplier: 2 hr.
  - Customer: As Needed

- **Equipment Use Time**
  - Supplier: 22 kW, 19 kW
  - Customer: 5 kW, 35 kW

- **Electric Demand**
  - Supplier: 7 kWh, 45 kWh
  - Customer: 21 kWh, 136 kWh

- **Electric Usage**
  - Supplier: 4 kW, 1,426 kWh
  - Customer: 9 kW, 38,000 pph (8 hr.) 367 ccf NG

- **Process**
  - Supplier: Grain Handling: 2 hr., Mash Cooking: 7 hr., 4 hr.
  - Customer: Spirits Gauging: 4 hr., Processing: 4 hr.

- **Product in Process**
  - Supplier: 8,000 gal., 13,000 gallons, 1,620 gallons
  - Customer: 100 gal., 8,000 gal., 300 Gal.

- **Cooling Water**
  - Supplier: 4,150 pph (3 hr.) 15 ccf NG
  - Customer: 270 pph (1.5 hr.) 0.4 ccf NG

- **Chilled Water**
  - Supplier: 0.50 gal., 0.25 gal.

- **Steam**
  - Supplier: 20,000 Gal.

- **As Needed**
  - Supplier: Mash Cooking: 8,000 gal.
  - Customer: 1,620 gal., 300 Gal.