LEED Building Design and Construction
Activity #5 – Water Efficiency (WE)
Before completing this Activity Read: Reference Guide for Building Design and Construction v4 – Pages 256-317

Note the following abbreviations are used in this activity:
NC LEED BD+C: New Construction and Major Renovation
CS LEED BD+C: Core and Shell Development
S LEED BD+C: Schools
R LEED BD+C: Retail
DC LEED BD+C: Data Centers
WDC LEED BD+C: Warehouses and Distribution Centers
HOS LEED BD+C: Hospitality
HC LEED BD+C: Healthcare

Although the LEED BD+C reference guide does not number the LEED prerequisites and credits, for this exercise they have been numbered in the order presented in the credit category.

Fill-In, Multiple Choice, Matching

1. Test your knowledge of how well you know the names of the credits for the Water Efficiency (WE) credit category:

LEED BD+C: NC, CS, S, R, DC, WDC, HOS, HC	
Credit	Name
P1	
P2	
P3	
C1	
C2	
C3	
C4	

2. Match the intent shown below to the prerequisite or credit:

LEED BD+C: NC, CS, S, R, DC, WDC, HOS, HC

Credit	ANS	Credit	ANS
WE – P1		WE – C1	
WE – P2		WE – C2	
WE – P3		WE – C3	
		WE – C4	

	INTENT
A	To conserve water used for cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.
B	To reduce indoor water consumption.
C	To reduce outdoor water consumption.
D	To support water management and identify opportunities for additional water savings by tracking water consumption.

3. List the four areas of water use that are addressed by the Water Efficiency (WE) credits:

   1.

   2.

   3.

   4.

4. The conservation and creative reuse of water are important because only _____ of Earth's water is fresh water, and of that, slightly over _____ is trapped in glaciers.

5. In the U.S., buildings account for _____ of potable water use, the third-largest category, behind thermoelectric power and irrigation.

6. Designers and builders can construct green buildings that use significantly less water than conventional construction by incorporating _____ landscapes that eliminate the need for _____, installing water efficient _____, and reusing _____, for nonpotable water needs.

7. WE Prerequisite Outdoor Water Use Reduction requirements:
   Reduce outdoor water use through one of the following options. _____ surfaces, such as _____ or _____ pavement, should be _____ from the landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be _____ or _____ at the project team's discretion.

   OPTION 1. _____ Irrigation Required
   Show that the landscape does not require a _____ irrigation system beyond a maximum _____ establishment period.

   OR

   OPTION 2. _____ Irrigation
   Reduce the project's landscape water requirement by at least _____ from the calculated baseline for the site's _____ watering month. Reductions must be achieved through plant _____ selection and irrigation system _____, as calculated by the Environmental Protection Agency (EPA) _____.

8. Good landscape design and use of _____, _____, and _____tolerant plants can dramatically reduce and even eliminate the need for irrigation while better integrating the building site into its surroundings and attracting native wildlife.

9. Native plants also tend to require less _____and fewer chemical _____, which degrade water quality when carried away in _____.

10. Projects with _____ landscape area are _____from this prerequisite.

11. For U.S. projects, the WaterSense Water Budget Tool automatically derives _____and _____from the project's _____.

12. Use the WaterSense Water Budget Data Finder to estimate the _____rate (ETo) in inches per month for the _____month of the year, based on a project's zip code.

13. Hot, dry, and windy locations have _____ ETo values than cool, humid locations.

14. WE Prerequisite Indoor Water use Reduction requirements:
Building Water Use
For the fixtures and fittings listed in Table 1, as applicable to the project scope, reduce aggregate water consumption by _____ from the baseline. Base calculations on the volumes and flow rates shown in Table 1.

All newly installed _____, _____, _____lavatory faucets, and _____that are eligible for labeling must be _____ labeled (or a local equivalent for projects outside the U.S.).

Complete Table 1. Baseline water consumption of fixtures and fittings:

Table 1. Baseline water consumption of fixtures and fittings

Fixture or fitting	Baseline (IP units)	Baseline (SI units)
Toilet (water closet)*		6 lpf
Urinal*		3.8 l[f
Public lavatory (restroom) faucet	_____ at 60 psi all others except private applications	1.9 lpm at 415 kPa, all others except private applications
Private lavatory faucet	_____ at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	_____ at 60 psi	8.3 lpm at 415 kPa
Showerhead*	_____ at 80 psi per shower stall	9.5 lpm at 550 kPa per shower stall

* _____

gpf = _____

gpm = _____

psi = _____

Appliance and Process Water Use
Install _____, _____, and _____within the project scope that meet the requirements listed in the tables below.

Complete Table 2. Standards for appliances

Table 2. Standards for appliances

Appliance	Requirement
Residential Clothes Washer	_____ or performance equivalent
Commercial Clothes Washer	
Residential Dishwasher (standard and compact)	_____ or performance equivalent
Prerinse spray valve	
Ice machine	_____ or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system

gpm = gallons per minute lpm = liters per minute

Complete Table 3. Standards for processes

Table 3. Standards for processes	
Process	**Requirement**
Heat rejection and cooling	No _____-through cooling with potable water for any equipment or appliances that reject heat
Cooling towers and evaporative condensers	Equip with • makeup water _____ • conductivity controllers and overflow _____ • efficient drift eliminators that reduce drift to maximum of _____ of recirculated water volume for counterflow towers and _____ of recirculated water flow for cross-flow towers

gpm = gallons per minute lpm = liters per minute

Healthcare, Retail, Schools, and Hospitality Only
In addition, water-consuming appliances, equipment, and processes must meet the requirements listed in Tables 4 and 5.

Complete Table 4. Standards for appliances

Table 4. Standards for appliances			
Kitchen equipment		**Requirement (IP units)**	**Requirements (SI units)**
	Undercounter	≤ 1.6 gal/rack	≤ 6.0 liters/rack
	Stationary, single tank, door	≤ 1.4 gal/rack	≤ 5.3 liters/rack
	Single tank, conveyor	≤ 1.0 gal/rack	≤ 3.8 liters/rack
	Multiple tank, conveyor	≤ 0.9 gal/rack	≤ 3.4 liters/rack
	Flight machine	≤ 180 gal/hour	≤ 680 liters/hour
	Batch	≤ 6 gal/hour/pan	≤ 23 liters/hour/pan
	Cook-to-order	≤ 10 gal/hour/pan	≤ 38 liters/hour/pan
	Countertop or stand	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
	Roll-in	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan

Complete Table 5. Process requirements

Table 5. Process requirements	
Process	**Requirement**
	Where local requirements limit discharge temperature of fluids into drainage system, use tempering device that runs water only when equipment discharges hot water OR Provide thermal recovery heat exchanger that cools drained discharge water below code-required maximum discharge temperatures while simultaneously preheating inlet makeup water OR If fluid is steam condensate, return it to boiler
	Use no device that generates vacuum by means of water flow through device into drain

The _____ label was developed by the U.S. Environmental Protection Agency to identify these efficient fixtures and ensure that higher efficiency does not come at the cost of performance.

15. Compliance Path 1 Prescriptive Achievement is for projects whose installed fixtures do not _____ _____ maximum levels. Compliance is documented through product _____ or fixture _____.

16. List the fixtures that the WaterSense label can be found for:

    1.

    2.

    3.

    4.

17. List the fixture types that are not labeled by WaterSense:

    1.

    2.

    3.

    4.

18. Complete Table 6. Maximum installed flush or flow rate for prescriptive path

Table 6. Maximum installed flush or flow rate for prescriptive path			
Fixture or fitting	**Maximum installed flush or flow rate (IP)**	**Maximum installed flush or flow rate (SI)**	**Threshold below code baseline**
Toilet (water closet)*		4.8 lpf**	
Urinal*		1.9 lpf	
Public lavatory (restroom) faucet		1.5 lpf	
Private lavatory faucets*		5.7 lpf	
Kitchen faucet		6.7 lpf	
Showerhead*		7.6 lpf	

* The WaterSense label is available for this fixture type.
**The average flush rate for dual-flush toilets must be calculated as the average flush volume of one full flush and two reduced flushes, using a 1:2 (high flush:low flush) ratio.
gpf = gallons per flush gpm = gallons per minute lpf = liters per flush lpm = liters per minute

19. Compliance Path 2 Usage-Based Calculation is for projects that cannot demonstrate the _____ reduction for each fixture, based on manufacturers' documentation. Using the indoor water use _____ provided by USGBC, the project team must perform calculations to show that, in aggregate, the fixtures comply with prerequisite requirements. Projects pursuing points under WE Credit Indoor Water Use Reduction _____ use this compliance path.

20. List the information that is required for the indoor water use calculator:

    1.

    2.

    3.

    4.

21. List the information required to complete the calculation for the design case (installed) flush and flow fixtures:

    1.

    2.

    3.

    4.

22. Complete Equation 1. Basic indoor water use reduction calculation

Daily water use for each fixture type = [ ] X [ ] X [ ] X [ ]

23. Appliances and equipment that use water on materials intended for _____ consumption may be _____. For example, bread and produce misters, soda machines, coffee-making machines, and fixtures used to fill sinks for washing produce are _____.

24. Lavatory faucets must be classified as _____ or _____. The Uniform Plumbing Code, International Plumbing Code, and the National Standard Plumbing Code each define private as those fixtures in _____, hotel or motel _____ rooms, and _____ rooms in hospitals. All other applications are deemed to be public.

25. Complete Table 7. Typical public and private lavatory faucet applications

Table 7. Typical public and private lavatory faucet applications

Lavatory faucet	Classification
Restroom sink School classroom sinks (if used primarily for hand washing)	
Residential bathroom sink Hotel or motel bathroom sink Dormitory bathroom sink Patient room sink Patient bathroom sink in hospital or nursing home	

gpm = gallons per minute lpm = liters per minute

26. Complete Table 8. Nonresidential default fixture uses

Table 8. Nonresidential default fixture uses

Fixture type	Duration (sec)	Uses per day			
		Employees (FTE)	Visitors	Retail Customers	Students
Water Closet (female)					
Water closet (male)					
Urinal (female)					
Urinal (male)					
Public lavatory faucet					
Shower					
Kitchen sink					

27. Complete Table 9. Residential default fixture uses

Table 9. Residential default fixture uses		
Equipment	**Duration (sec)**	**Uses per day**
Water Closet (female)		
Water closet (male)		
Private lavatory faucet		
Shower		
Kitchen sink		

28. Rating System Variations

    Core and Shell

    If no eligible plumbing fixtures, appliances, and process water are installed as part of the Core and Shell project scope of work, the project _____ achieves this prerequisite.

    Schools

    For K–12 schools that close on weekends, holidays, and for eight weeks of school vacation, assume _____ days of operation.

29. Complete Table 10. Default uses in schools, by occupancy type

Table 10. Default uses in schools, by occupancy type			
Fixture type	**FTE**	**Student**	**Visitor**
Water Closet			
Female			
Male			
Urinal			
Female			
Male			
Lavatory faucet			
Shower			
Kitchen sink			

30. WE Prerequisite Building-Level Water Metering requirements:

    Building Water Use

    Install _____ water meters that measure the _____ potable water use for the building and associated grounds. Meter data must be compiled into _____ and annual summaries; meter _____ can be manual or automated.

    Commit to _____ with USGBC the resulting whole-project water usage data for a _____-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes first. This commitment must carry forward for five years or until the building changes ownership or lessee.

31. List examples of end uses of potable water in a project building and on the grounds:

    1.

    2.

    3.

    4.

    5.

    6.

    7.

    8.

32. If all water comes from a _____ water supply and the utility's water meter provides _____ consumption data, that system's _____ meets the prerequisite requirements.

33. WE Credit Outdoor Water Use Reduction requirements:
    Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be _____ from landscape area calculations. Athletic fields and _____ (if vegetated) and food _____ may be included or excluded at the project team's discretion.

    Option 1. No Irrigation Required (2 points except Healthcare, 1 point Healthcare)
    Show that the landscape does not require a _____ irrigation system beyond a maximum _____-year establishment period.

    OR

    Option 2. Reduced Irrigation (2 points except Healthcare, 1 point Healthcare)
    Reduce the project's landscape water requirement (LWR) by at least _____ from the calculated baseline for the site's _____ watering month. Reductions must first be achieved through plant _____ selection and irrigation system _____ as calculated in the Environmental Protection Agency (EPA) WaterSense Water Budget Tool. Additional reductions beyond _____ may be achieved using any combination of efficiency, alternative water sources, and smart scheduling technologies.

34. Complete Table 1. Points for reducing irrigation water

Table 1. Points for reducing irrigation water		
Percentage reduction from baseline	**Points (except HC)**	**Points (HC)**

35. List examples of alternative water sources:

    1.

    2.

    3.

    4.

    5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

36. Condensate and cooling tower _____ in particular may have _____ levels precluding use for irrigation.

37. WE Credit Indoor Water Use Reduction requirements:
    Further reduce fixture and fitting water use from the calculated _____ in WE Prerequisite Indoor Water Use Reduction. Additional potable water savings can be earned above the prerequisite level using _____ water sources. Include fixtures and fittings necessary to meet the needs of the occupants. Some of these fittings and fixtures may be outside the project boundary. Points are awarded according to Table 1.

38. Complete Table 1. Points for reducing water use

Table 1. Points for reducing water use

Percentage reduction	Points (NC, CS, DC, WDC)	Points (S, R, HOS, HC)

AND

39. Appliance and Process Water
    Install equipment within the project scope that meets the minimum requirements in Table 2, 3, 4, or 5. _____ point is awarded for meeting all applicable requirements in any _____ table. All applicable equipment listed in each table must meet the standard.

    Schools, Retail, and Healthcare projects can earn a _____ point for meeting the requirements of _____ tables. To use Table 2, the project must process at least _____ lbs (57 606 kg) of laundry per year.

40. Complete Table 2. Compliant commercial washing machines

Table 2. Compliant commercial washing machines		
Washing machine	**Requirements (IP)**	**Requirements (SI)**
On-premise, minimum capacity 2,400 lbs (1088 kg) per 8-hour shift	Maximum _____ gals per pound*	Maximum _____ liters per 0.45 kilograms*

* Based on equal quantities of heavy, medium, and light soil laundry.

41. To use Table 3, the project must serve at least _____ meals per day of operation. All process and appliance equipment listed in the category of kitchen equipment and present on the project must comply with the standards.

42. Complete Table 3. Standards for commercial kitchen equipment

Table 3. Standards for commercial kitchen equipment			
Kitchen equipment		**Requirement (IP units)**	**Requirements (SI units)**
	Undercounter	ENERGY STAR	ENERGY STAR or performance equivalent
	Stationary, single tank, door	ENERGY STAR	ENERGY STAR or performance equivalent
	Single tank, conveyor	ENERGY STAR	ENERGY STAR or performance equivalent
	Multiple tank, conveyor	ENERGY STAR	ENERGY STAR or performance equivalent
	Flight machine	ENERGY STAR	ENERGY STAR or performance equivalent
	Batch (no drain connection)	≤ 6 gal/hour/pan	≤ 23 liters/hour/pan
	Cook-to-order (with drain connection)	≤ 10 gal/hour/pan	≤ 38 liters/hour/pan
	Countertop or stand	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
	Roll-in	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
	Disposer	3-8 gpm, full load condition, 10 minute automatic shutoff; or 1 gpm, no-load condition	11–30 lpm, full load condition, 10-min automatic shutoff; or 43.8 lpm, no-load condition
	Scrap collector	Maximum 2 gpm makeup water	Maximum 7.6 lpm makeup water
	Pulper	Maximum 2 gpm makeup water	Maximum 7.6 lpm makeup water
	Strainer basket	No additional water usage	No additional water usage

43. To use Table 4, the project must be a _____ or _____ facility.

44. Complete Table 4. Compliant laboratory and medical equipment

Table 4. Compliant laboratory and medical equipment

Lab equipment	Requirement (IP)	Requirements (SI)
Reverse-osmosis water purifier	_____ recovery	_____ recovery
Steam sterilizer	For 60-inch sterilizer, _____ gal/U.S. tray For 48-inch sterilizer, _____ gal/U.S. tray	For 1520-mm sterilizer, 28.5 liters/DIN tray For 1220-mm sterilizer, 28.35 liters/DIN tray
Sterile process washer	_____ gal/US tray	1.3 liters/DIN tray
X-ray processor, 150 mm or more in any dimension	_____ processor water recycling unit	
Digital imager, all sizes		

45. To use Table 5, the project must be connected to a municipal or district steam system that does not allow the return of steam condensate.

46. Complete Table 5. Compliant municipal steam systems

Table 5. Compliant municipal steam systems

Steam system	Standard
Steam condensate disposal	_____ municipally supplied steam condensate (no return) to drainage system with heat recovery system or reclaimed water
OR	
Reclaim and use steam condensate	_____ recovery and reuse

47. WE Credit Indoor Water Use Reduction exemplary performance is earned if the project achieves a _____ water use reduction.

48. WE Credit Cooling Tower Water Use requirements:
For cooling towers and evaporative condensers, conduct a one-time _____ water analysis, measuring at least the _____ control parameters listed in Table 1.

49. Complete Table 1. Maximum concentrations for parameters in condenser water

Table 1. Maximum concentrations for parameters in condenser water	
Parameter	**Maximum level**

ppm = parts per million
µS/cm = micro siemens per centimeter

50. Calculate the number of cooling tower _____ by dividing the maximum allowed concentration level of each parameter by the actual concentration level of each parameter found in the potable makeup water. _____ cooling tower cycles to avoid exceeding maximum values for any of these parameters.

51. Complete Table 2. Points for cooling tower cycles

Table 2. Points for cooling tower cycles	
Parameter	**Points**
Maximum number of cycles achieved without exceeding any filtration levels or affecting operation of condenser water system (up to maximum of 10 cycles)	
Achieve a minimum 10 cycles by increasing the level of treatment in condenser or make-up water OR Meet the minimum number of cycles to earn 1 point and use a minimum 20% recycled nonpotable water	

52. Cooling tower or evaporative condenser water efficiency is measured in the _____ of recirculation cycles before water must be removed by _____.

53. List examples of good nonpotable water sources:

    1.

    2.

    3.

    4.

    5.

    6.

54. WE Credit Water Metering requirements:
    Install _____ water meters for _____ or more of the following water subsystems, as applicable to the project:

    _____. Meter water systems serving at least _____ of the irrigated landscaped area. Calculate the percentage of irrigated landscape area served as the total metered irrigated landscape area

divided by the total irrigated landscape area. Landscape areas fully covered with _____ or _____ vegetation that requires no routine irrigation may be _____ from the calculation.

_____. Meter water systems serving at least _____ of the indoor fixtures and fitting described in WE Prerequisite Indoor Water Use Reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.

_____. Meter water use of at least _____ of the installed domestic hot water heating capacity (including both tanks and on-demand heaters).

Boiler with aggregate projected annual water use of _____ gallons (378 500 liters) or more, or boiler of more than _____ BtuH (150 kW). A single makeup meter may record flows for multiple boilers.

_____. Meter reclaimed water, regardless of rate. A reclaimed water system with a makeup water connection must also be metered so that the true reclaimed water component can be determined.

_____. Meter at least _____ of expected daily water consumption for process end uses, such as humidification systems, dishwashers, clothes washers, pools, and other subsystems using _____ water.

Healthcare Projects only
In addition to the requirements above, install water meters in any _____ of the following:
_____ water systems (reverse-osmosis, de-ionized);
_____backwash water;
water use in _____department;
water use in _____;
water use in _____;
water use in central _____and processing department;
water use in physiotherapy and _____and treatment areas;
water use in _____suite;
_____ hydronic system makeup water; and
_____ makeup for domestic hot water systems.

55. _____ the major building water systems provides a way to formulate independent system baselines, _____ usage against those baselines, isolate and identify potential sources of _____, and take _____ action.