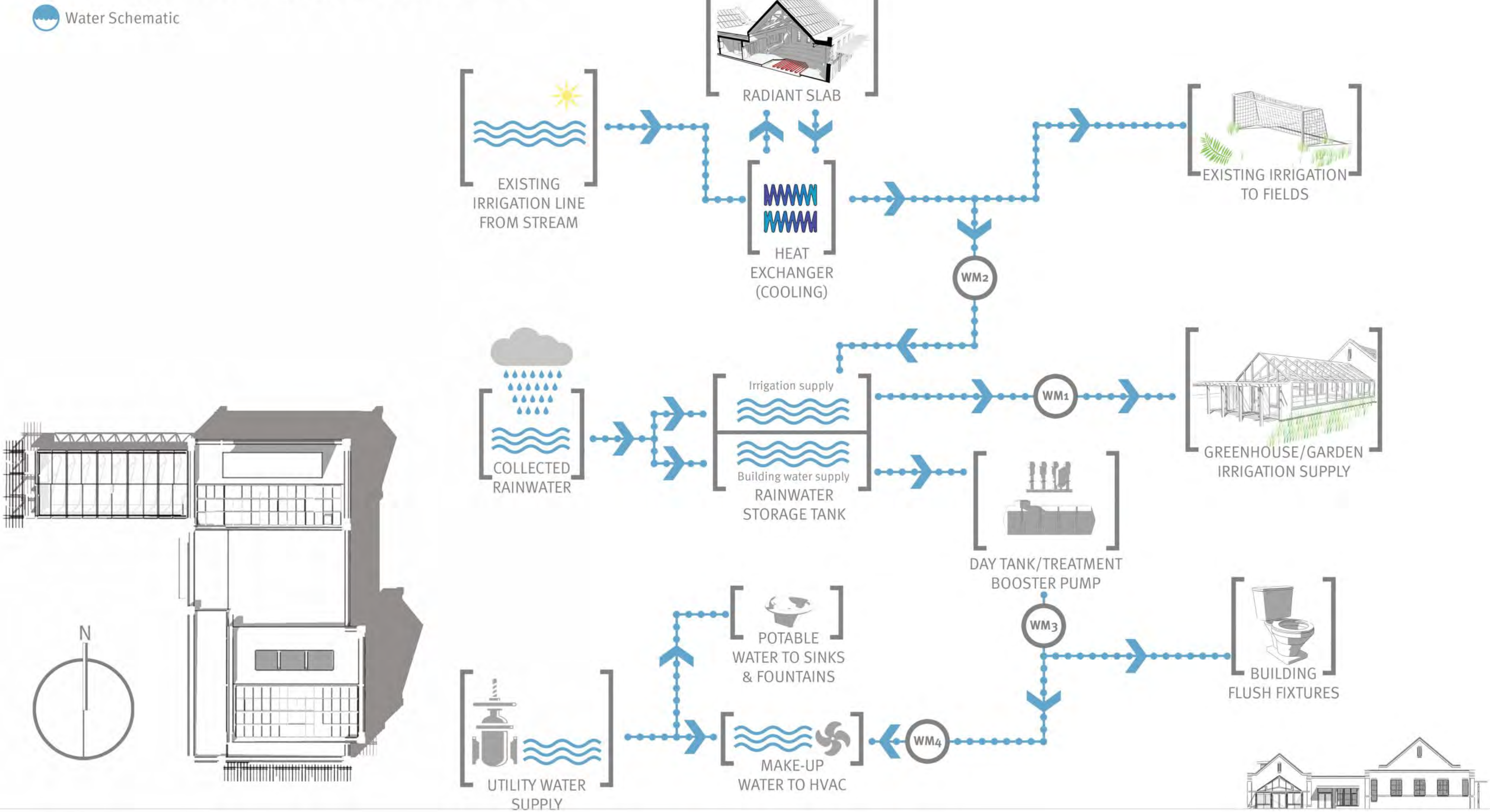
Appendix B:

Water Flow Schematic

[net-zero energy, LEED platinum certified] *September, 2010*

HOOD RIVER MIDDLE SCHOOL

Water Schematic



WM# = WATER METER

INTERFACE ENGINEERING

Appendix C:

Project Statistics and Features

Project Statistics and Features

Building Location:
1602 May St., Hood River, OR 97031
45° 42’ 18” N; 121° 31’ 37” W
Elevation: 433’

Design and Construction Team:
Owner: Hood River County School District
Architect: Opsis Architecture, LLP
General Contractor: Kirby Nagelhout Construction Company
Civil Engineer: KPFF Consulting Engineers
Landscape Architect: GreenWorks PC
Structural Engineer: KPFF Consulting Engineers
Mechanical, Electrical and Plumbing Engineers: Interface Engineering
Acoustical and Technology Engineer: Listen Acoustics
Graphics Consultant: Anderson Krygier, Inc.

Square Footages:
Music and Science Building Level 1: 5,131 sf
Music and Science Building Mezzanine: 200 sf
Attached Greenhouse: 968 sf
Detached Storage Building: 588
Total conditioned space: 5,331 sf
Total space served by electrical meter: 6887 sf
(Note that the new site lighting is also fed through the building’s electrical meter.)

Program:
Music Classroom: 1809 sf (net)
Music Teacher Office: 108 sf
Practice Room 1: 67 sf
Practice Room 2: 67 sf
Science Classroom: 979 sf
Science Teacher Office: 95 sf
Greenhouse: 968 sf
Girls Restroom: 124 sf
Boys Restroom: 105 sf
Custodial Room: 37 sf
Electrical Room: 91 sf
Mechanical Mezzanine: 200 sf

Materials and Systems:

Exterior Wall Assembly:

- Exterior brick veneer
- Air space
- Fluid applied moisture barrier
- Insulated concrete formwork (2 ½" foam insulation)
- 6" or 8" reinforced concrete
- Insulated concrete formwork (2 ½" foam insulation)
- Gypsum wall board (95% recycled gypsum content)
- Low VOC paint

Interior Wall Assembly

- Insulated concrete formwork at science room south wall or 2x6 wood framing (reused from building demolished on site).
- Sound batt insulation where needed for acoustics
- Hat channels and resilient clips where needed for acoustics
- Gypsum wall board (95% recycled gypsum content)
- Low VOC paint

Cabinets:

- High recycled content, no VOC particle board
- FSC certified wood veneers
- Countertops: Recycled paper and bamboo fiber content

Display Cases: Bamboo, glass

Tack boards: Cork

Acoustic Panels:

- Fabric covered absorbtive panels at classrooms and practice rooms
- Wood diffuser panels at music room

Windows:

- Pella triple glazed windows
- Cardinal LowE366[3] glazing

Skylights:

- Kalwall gel insulated panels

Floor:

- Radiant concrete slab over 2" rigid insulation
- Linoleum finish at music room
- Exposed concrete typical
- Ceramic tile finish at restrooms
- Walk off mats at entries

Ceiling:

- Acoustical tile with straw content at practice rooms
- Exposed structure elsewhere
- Gypsum at restrooms, science office

Roof structure and assembly:

- Reused 3x12 wood joists from the deconstructed bus barn's floor were sand blasted and assembled into scissor trusses.
- 2x6 Tongue and Groove wood decking
- Plywood sheathing
- R-40 rigid insulation
- Standing seam metal sloped roofs and TPO membrane low slope roofs

Mechanical systems:

- Ground source heat pump 'geo-exchange' system
- Heat exchange loop from existing stream for cooling
- Radiant slab heating and cooling
- Rooftop heat recover ventilation units
- 'SolarWall' transpired metal deck under solar panels for passive pre-heat of ventilation air

Plumbing systems:

- 14,000 gallon rainwater storage tank
- Ozone treatment for rainwater use for toilet flushing
- Low flow toilets and faucets
- Waterless urinal at boys restroom

Electrical systems:

- High efficiency direct/indirect linear fluorescent fixtures
- Occupancy and daylight sensors
- Switched plugs on occupancy sensors
- 35 Kw Sanyo Solar PV array

Appendix D:

Interpretive and Insert Signage

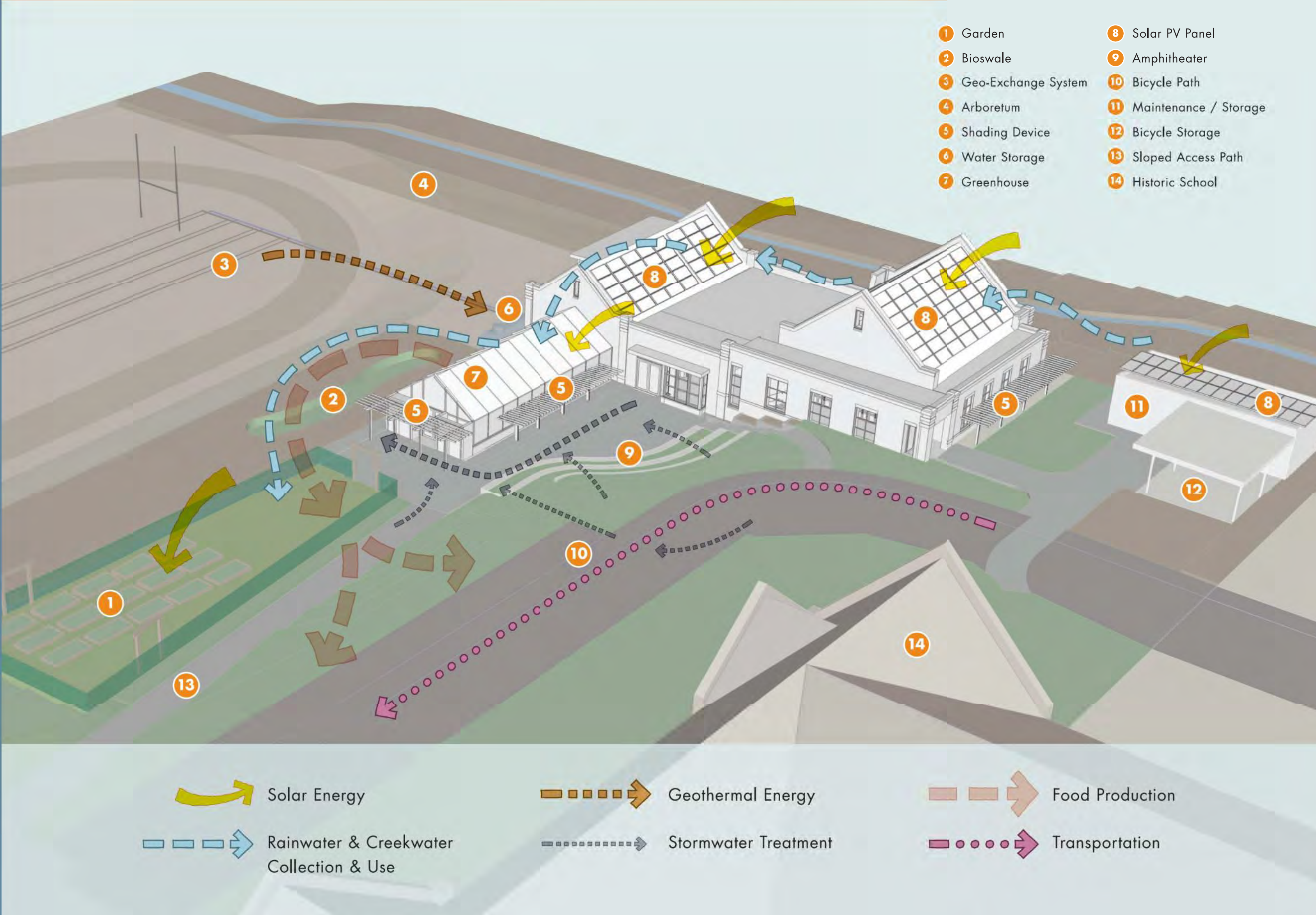
HOOD RIVER MIDDLE SCHOOL Music & Science Building

Goal

Reduce the use of resources and increase environmental awareness through design, construction and use of the building and grounds.

Methods

- Create a net-zero energy building that uses no more energy than it creates through efficient building systems and responsible use of resources available on the site.
- Create a building that teaches sustainable concepts and systems.
- Reduce impact on the water cycle.
- Reduce use of building material through the use of recycled and re-used materials.
- Create an environment that is conducive to health and learning by making good use of daylight, acoustical properties and natural ventilation.
- Create a site that can be used to produce food, provide habitat for native species, compost waste and bring community together.



Hood River Middle School

A net-zero energy building uses a variety of tools to create and save energy on site.

Net-zero energy goal

The goal is to use no more energy in the building than can be harvested on the grounds. To accomplish this, the building is designed to reduce energy loads to 60% less than a typical school building. The remaining energy used in the building is produced using photovoltaic panels and the sun's energy to pre-heat the air used for ventilation.

GLOSSARY

Foundation
A structure that transfers the weight of the building to the earth so it does not shift or sink into the ground.

Gypsum Board
A material that is used to cover the wall structure and give it a smooth finish, also known as "sheetrock" or "drywall".

Header
The structure that spans over the top of a window to hold up the wall above.

Insulating Concrete Forms (ICF)
Foam blocks with hollow cavities that are stacked on top of one another, then filled with steel reinforcing bar (rebar) and concrete to create energy-efficient walls.

Precast Concrete
Concrete that is poured and cured off-site. At this building light colored precast concrete is used with brick to mimic the decorative terra cotta clay that was used on the original 1927 building.

Rebar
Steel bar that is used inside concrete to give it strength in tension (pulling) as well as compression (pushing).

R-value
A measure of the resistance of an insulating or building material to heat flow. Materials with a high R-value are good insulators.

Recycled Content
The portion of a material that was previously used for another purpose.

Solar Photovoltaic (PV) Panels
Panels that convert solar energy into electricity.

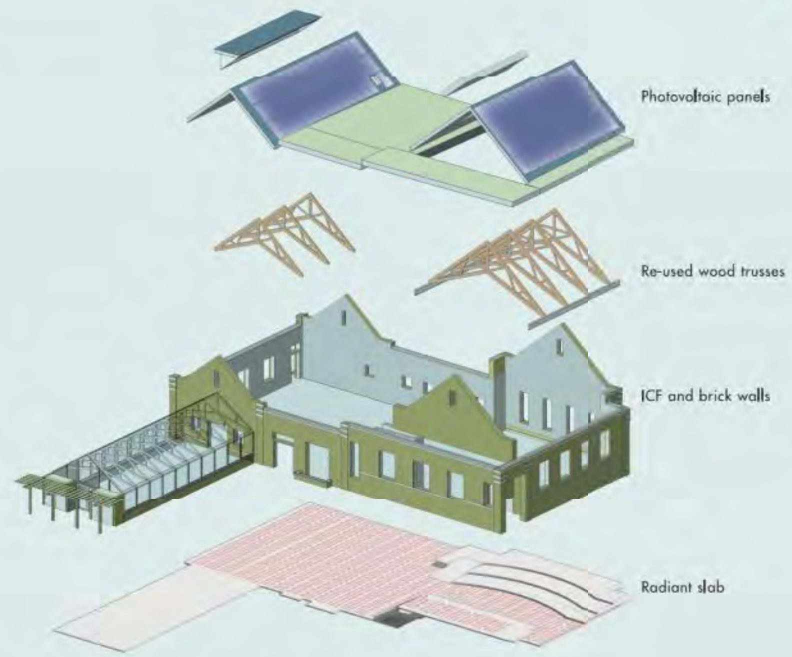
Standing Seam Metal Roof
Sheet metal with raised edges that prevent water from leaking in.

Thermal Mass
Materials such as concrete and water that are said to have a high 'thermal mass' are able to absorb heat during the day and radiate it into the building at night, thereby making the building more energy efficient

TPO
ThermoPlastic Olefin is a membrane material used on low-slope roofs. Its white color helps reflect radiation and reduce heat gain.

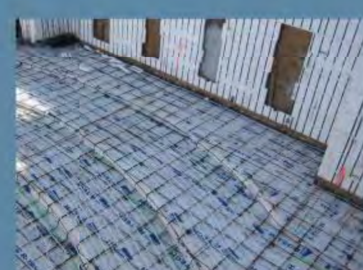
Vapor Barrier
A sheet of material that prevents water vapor from passing through. Water vapor that enters a wall, then cools and condenses, can allow mold to grow.

Veneer
A thin layer of material such as wood, brick or stone covering another backing material.



This axonometric view shows the building components from slab to solar panel.

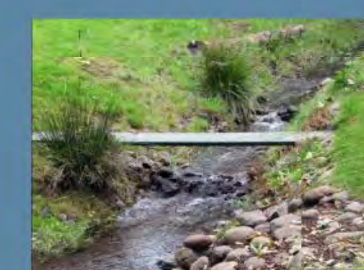
Geo-Exchange System
A system of pipes runs 15 feet below the surface of the adjacent football field, where liquid is warmed or cooled by the relatively constant temperature of the earth. The energy produced from this system is used to heat and cool the radiant slab.



Radiant Slab
The concrete floor slab is heated and cooled by liquid running through pipes in the slab. This energy radiates into the building.

Efficient Lighting
Daylight sensors will automatically dim the lights according to the amount of daylight in the classrooms, and if the last person to leave the room forgets to turn off the lights, the occupancy sensors will automatically shut off the lights after a few minutes.

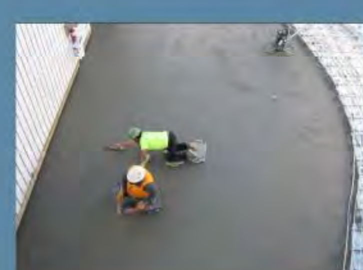
Daylighting
Good daylighting can save energy by allowing electric lights to be turned off during daytime hours. In classrooms, it is important that the quantity of daylight is balanced throughout the room. Too much contrast can make it difficult for the eyes to adjust. High monitor lights, skylights and reflective panels bring light deep into the science and music classrooms.



Irrigation Water
The radiant slab system takes advantage of cold water from an adjacent stream by harvesting its coldness with a heat exchanger. This is used to cool the slab during the summer as the water passes by on its way to irrigate the school grounds.

Shading Device
Shading Devices/Trellises with deciduous vines shade the south-facing windows to help block heat gain and glare, especially in summer when sun angles are high and heat gain is undesirable.

Insulation
A thick envelope of insulation encloses the building and keeps the indoor temperature relatively constant.



Thermal Mass
The concrete walls and slab provide thermal mass which can absorb excess heat during the day and radiate it into the building at night, when it is needed most.

Solar Panels
Solar panels produce electricity for use in the building, or it can be fed into the electricity grid for use elsewhere. While there is no battery system to store energy on site, the goal is for the panels to produce as much energy over the course of a year as is needed to power the building.

Pre-heated Air
There is a one-foot-deep air space under the north section of the solar panels that is designed to be heated by the sun, then used for building ventilation. This will save air heating energy and will also cool the underside of the solar panels, thereby making them more efficient.

Mechanical Ventilation
Unlike many, this building uses carbon dioxide sensors to detect when ventilation is needed, rather than ventilating whenever the building is occupied. In addition, it uses displacement ventilation which allows air to move slowly into the space through large ducts, rather than forcing air through small ducts with energy consuming fans.

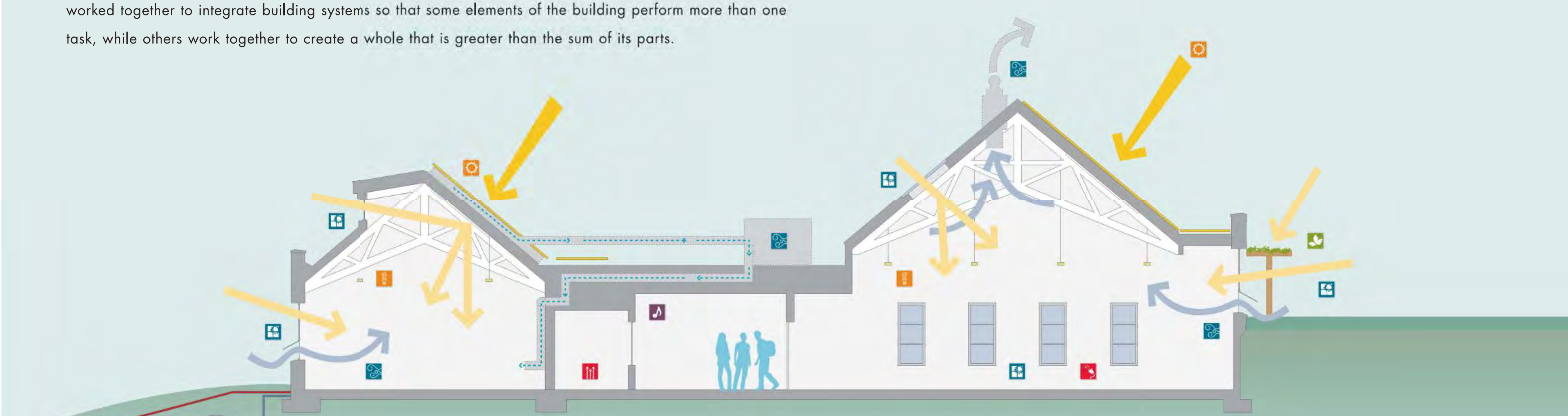
Natural Ventilation
When outside temperatures are appropriate, a green light indicates that windows and the rooftop rotary ventilator can be opened. If operated correctly, this can save on heating, cooling and ventilation costs.

Integrated Design

Building systems integration:
air, light, power, sound, water, temperature

How does this building work?

Many strategies were used to conserve resources in this building. Architects and different types of engineers worked together to integrate building systems so that some elements of the building perform more than one task, while others work together to create a whole that is greater than the sum of its parts.



Solar panels convert sun energy into electricity. Air flow behind the panels is pre-heated for use in the building.

Energy-efficient lighting is computer-controlled to dim in response to available daylight in the room.

Deciduous vines growing on an exterior trellis block hot summer sunlight, but allow in winter sunlight to warm the building.

When outside air temperatures are comfortable, a light indicates that windows and rooftop ventilators should be opened to allow fresh air into the building.

Translucent skylights, clerestory windows and traditional windows create an even distribution of daylight in classrooms, thereby reducing the need for electric lighting.

Air is delivered at a slow speed low in the room providing an efficient system that conditions the air where people are.

A water tank collects rainwater from the roof so it can be re-used for toilet flushing and irrigation.

Many walls are specially constructed with gaps between materials to deaden sound transfer between spaces.

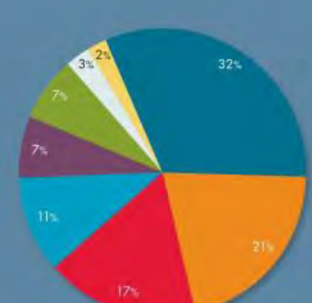
To conserve energy, bottom electrical outlets shut off automatically when the room is empty.

Radiant slabs contain plastic piping that distributes hot water for winter heating and summer cooling. Below slab insulation minimizes energy transfer into the ground.

Building Energy Use

What is the estimated energy use for a typical school building of this size and location?

What is the estimated energy use for this building?



Baseline Building

MBtu per year	Type of use	MBtu per year
96.1	Ventilation Fans	14.9
62.8	Interior Lighting	31.5
51.9	Space Heating	15.1
32.6	Miscellaneous Equipment	26.1
21.1	Water Heating	11.7
19.1	Exterior Use	8.8
9	Space Cooling	3.3
6.1	Pumps	8.5
298.7	**TOTAL**	**119.9**

Design Estimate

How much energy is used per square foot of building in the course of one year?

EUI = Energy Use Index

Building square footage = 5,331 square feet of conditioned space
(including mechanical mezzanine but excluding the greenhouse)

Baseline EUI:
298.7 MBtu per year ÷ 5,331 = 56 KBtu per square foot per year

Design EUI:
119.9 MBtu per year ÷ 5,331 = 22.5 KBtu per square foot per year

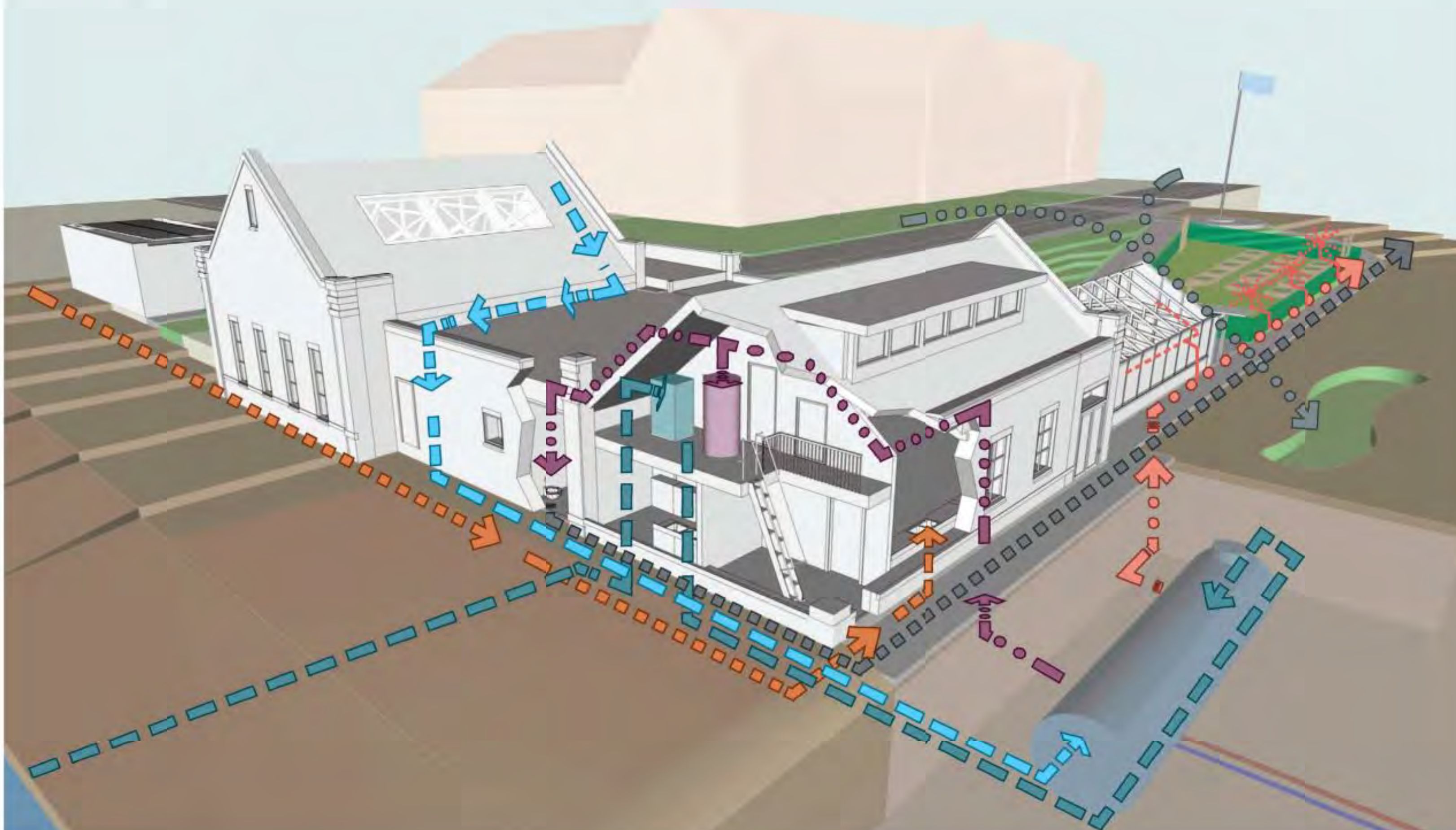
Projected savings over baseline building = 60.1%

What efficiency measures were used to save energy and how much energy will they save?

	MBtu per year	percent of total
Extra Insulation	24.3	13.6
Efficient Lighting	14.1	7.9
Daylighting	14.1	7.9
Switched Plugs	3.8	2.1
Geothermal/Radiant Slab Heating & Cooling System	56.9	31.8
Efficient Ventilation Fans	15.9	8.9
Sensor-driven Ventilation	7.7	4.3
Passive Solar Ventilation	21.1	11.8
Efficient Water Heating	2.5	1.4
Irrigation Water Cooling System	18.4	10.3

Water Cycles

Water changes form and is used for different purposes as it moves through a cycle of evaporation, condensation, precipitation and collection. One phase of the cycle occurs at this location, where water occurs as rainwater, stream-water, water from the city's system, stormwater, irrigation water, waste water, drinking water and toilet water.



Water moves through the site

Much of the water for the building is collected, treated, processed (for heat), stored, used and re-treated onsite. Potable water (for sinks and fountains) is supplied through the city's water system.

Rainwater
Collected onsite from roof surfaces and stored in an underground tank.

Streamwater
Water diverted from the creek is used for irrigation and flows through a heat exchanger to provide additional cooling for the building.

City Water
Treated water is delivered by the city's water system for potable (drinking) water uses

Irrigation Water
Water is collected from various sources onsite and used to irrigate fields and gardens.

Toilet Water
Rainwater is collected and filtered onsite and then used in the building's toilets.

Blackwater
Waste water from toilets and sinks is sent to a sewage treatment facility for treatment.

Stormwater
Rainfall is collected from onsite roads, paths and sidewalks, and is treated in the onsite bioswale.

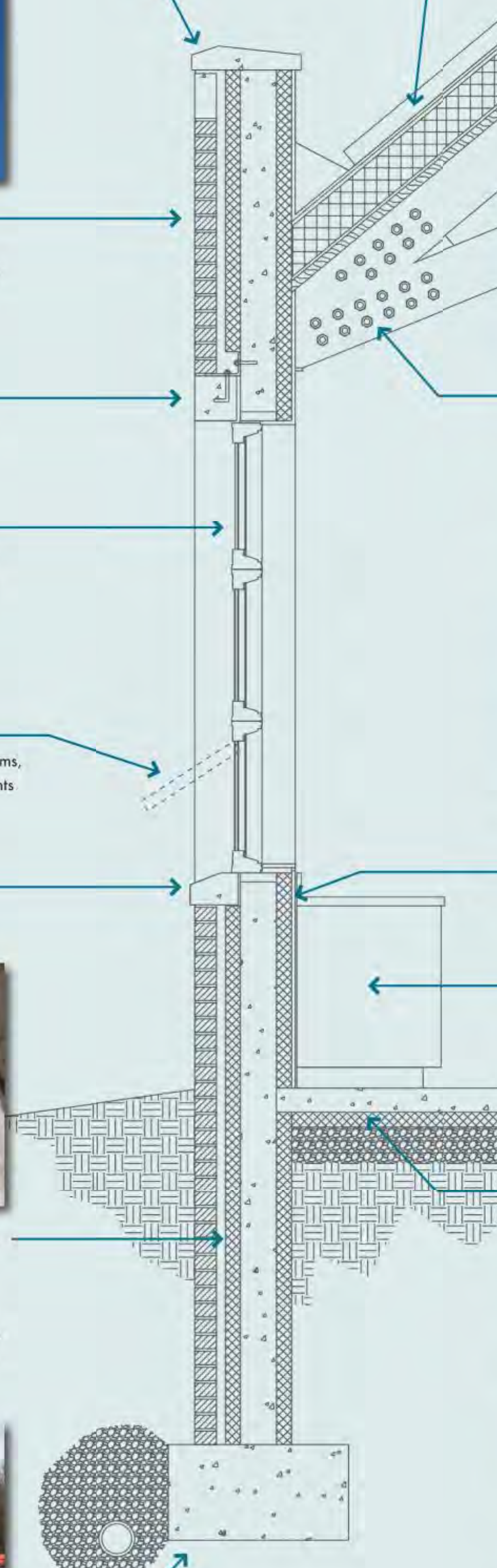
What does it take to store water onsite?
Rainwater that falls onto the roof is collected and stored in an underground tank and used for non-drinking water purposes.

How do we move the water?
A series of pumps and pipes controls the water flow through the building systems.

How can we clean the water?
Some of the water for the building is treated onsite. This water can be used for irrigating plants and flushing toilets. Drinking water is supplied through the city's water systems.

Building Materials

A slice through the building shows how it is constructed



Precast Parapet Cap
A cap of precast concrete seals the top of the wall and provides a decorative element.

Brick
A non-structural brick veneer with an air gap behind it screens water away from the building and ties the building to its historic context.

Precast Header
A precast concrete header supports the brick above doors and windows.

Windows
The wood windows have an aluminum surface outside to protect them from the elements and have three panels of glass to increase their insulating and acoustic benefits.

Operable Windows
In addition to providing daylight to the classrooms, some windows can be opened to allow occupants to control natural ventilation.

Precast Concrete Sill
A precast concrete sill helps shed water.

Insulated Concrete Formwork (ICF)
Foam blocks are stacked like legos. The steel rebar and concrete are placed inside to make strong walls that are also well insulated, reduce sound transfer and have a good thermal mass.

Foundation System
A concrete foundation foot supports the building's weight and transfers it into the ground. A foundation drain keeps water away from the building foundation.

Roof System
Standing seam metal roofing on high slopes and thermoplastic polyolefin (TPO) nembrane on low slopes keep water out and reflect heat with their light color. Thick insulation keeps interior temperatures steady and wood decking with a layer of plywood sheathing form a stiff layer of structure.

Roof Trusses
Trusses support the roof using wood recycled from the bus barn building that was built in the 1940s and torn down to make room for this building. The wood pieces are held together with steel plates and bolts. Recycled wood was also used as the framing for many interior walls.

Gypsum Wall Board
Wall board is made from 95% recycled material and provides a smooth interior finish.

Cabinets
Cabinetry is constructed with board made from 100% recycled wood fibers and a birch wood veneer. The countertops in the science classroom are made from durable quartz with recycled content, while countertops in the teacher offices are made from recycled paper.

Floor System
The floor system consists of a radiant concrete slab which contains steel rebar and plastic pipe, and can heat or cool the concrete by pumping fluid through it. Under the concrete is a layer of insulation and a plastic sheet vapor barrier to keep cold and moisture from rising into the concrete. The whole assembly sits on a solid surface of compacted gravel and earth.