CONSTRUCTED WETLANDS FOR RURAL WASTEWATER TREATMENT

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SMALL COMMUNITIES, BIG PROBLEMS…

CITY OF JULIAETTA, IDAHO POPULATION 609
FACILITY BUILT IN 1977 STILL USES THE MAJORITY OF THE ORIGINAL EQUIPMENT.

- AGING INFRASTRUCTURE
- INCREASINGLY STRINGENT WATER QUALITY STANDARDS
- $$$$$ SYSTEM UPGRADES
- SMALL TAX BASE
- STAFFING FOR M&O

TOMPKINS, 2017.

QUICK FACTS:

THERE ARE 187 CITIES IN IDAHO WITH A POPULATION LESS THAN 5,000

IN ADDITION, THERE ARE UNINCORPORATED COMMUNITIES & SUBDIVISIONS USING CENTRALIZED WASTEWATER TREATMENT SYSTEMS

FROM 2015-2018, THE IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY FUNDED CONSTRUCTED LOANS FOR 8 IDAHO CITIES (POPULATION <6,000) TOTALING OVER $60,000,000

TRADITIONAL TECHNOLOGY

GOOGLE EARTH, 2019.

LAGOONS ARE COMMONLY USED FOR WASTEWATER TREATMENT IN SMALL COMMUNITIES, BUT PROVIDE NO ANCILLARY BENEFITS. RENOVATIONS STILL COST MILLIONS…

CURRENT ISSUES

TRADITIONAL LAGOON INFRASTRUCTURE IS AGING AND WILL COST MILLIONS OF DOLLARS TO REPLACE

NEW DISCHARGE PERMITS CONTAIN HIGHER STANDARDS THAN BEFORE…

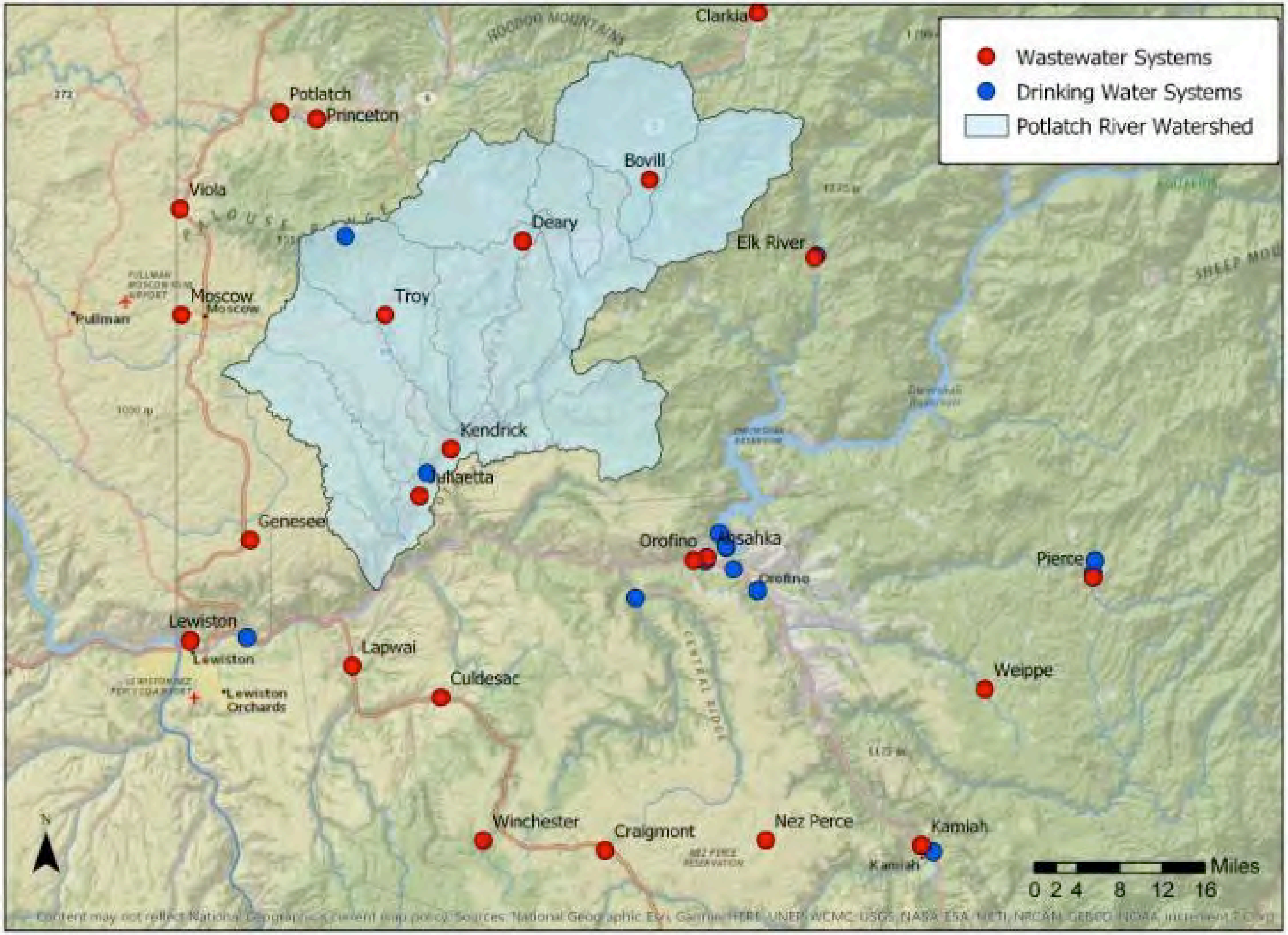
SUCH AS AMMONIA, PHOSPHOROUS, AND WATER TEMPERATURE

CITIES OBTAIN DRINKING WATER FROM THE SAME RIVERS THAT RECEIVE TREATED WASTEWATER

EFFECTIVE WASTEWATER TREATMENT → COST SAVINGS FOR CLEAN DRINKING WATER

OPEN SOURCE IMAGES, 2019.

Drinking Water Sources & Wastewater Discharge in the Potlatch River Watershed & Vicinity



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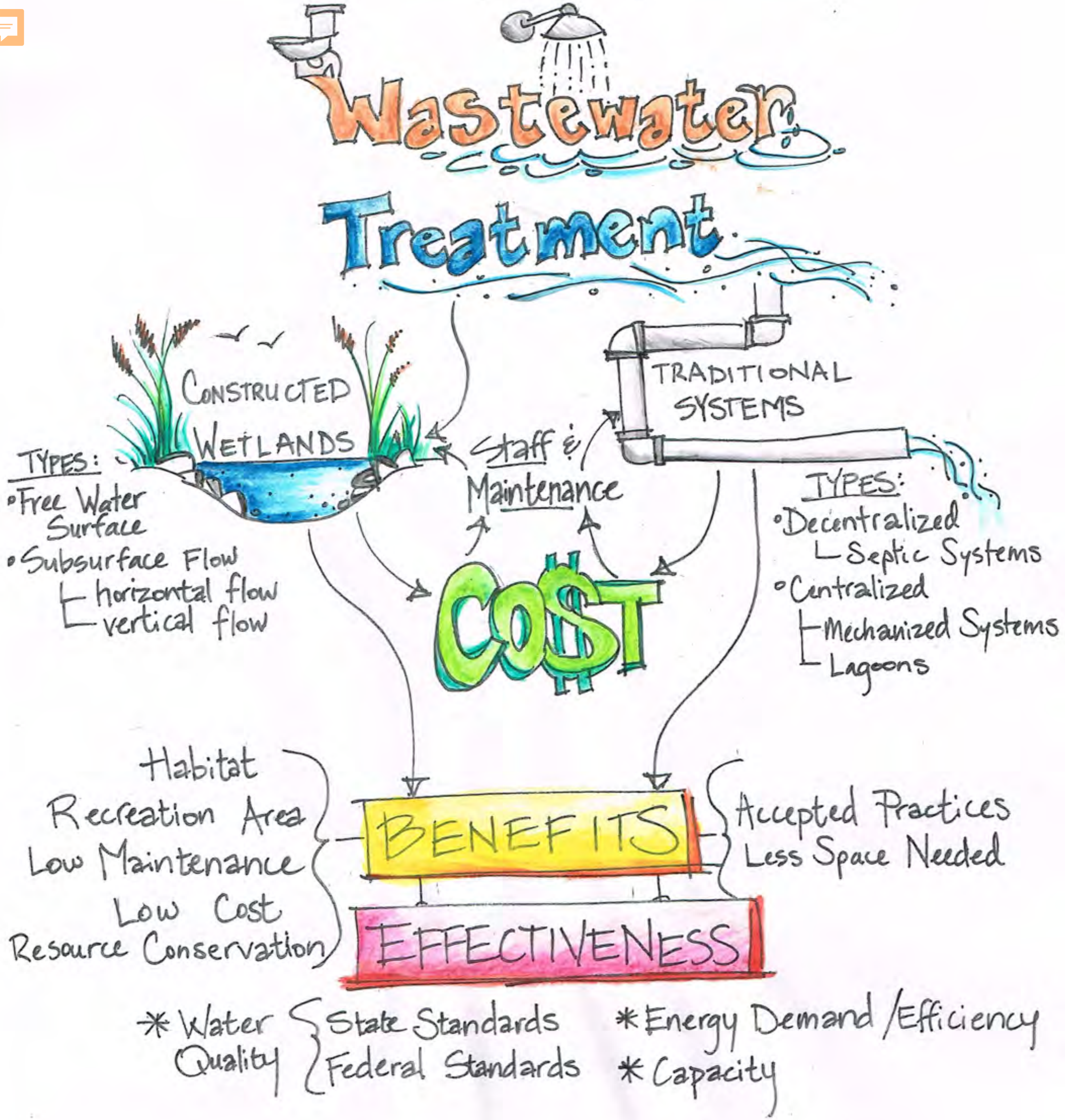
TIME FOR CHANGE…

INFRASTRUCTURE IS REACHING THE END OF ITS USEFUL LIFE

IT IS EXPECTED THAT MANY FACILITIES WON'T BE ABLE TO MEET STANDARDS OF NEW DISCHARGE PERMITS

CONSTRUCTED WETLANDS MAY BE THE OPTION COMMUNITIES CAN'T AFFORD TO REFUSE!



PROJECT SCOPE & GOALS

- IDENTIFY THE CRITICAL COMPONENTS OF A CONSTRUCTED WETLAND
- IDENTIFY CHALLENGES AND SOLUTIONS TO PERMITTING AND FUNDING
- COMPARE COST AND BENEFITS OF CONSTRUCTED WETLANDS TO TRADITIONAL WASTEWATER TREATMENT METHODS

WHY CONSTRUCTED WETLANDS?

HAVE LOW ENERGY NEEDS AND FEWER OPERATIONAL REQUIREMENTS COMPARED TO CONVENTIONAL WASTEWATER TREATMENT SYSTEMS

CAN PRODUCE HIGH QUALITY EFFLUENT AND AT LOWER POWER REQUIREMENTS THAN CONVENTIONAL ACTIVATED SLUDGE SYSTEMS

OFFER SEVERAL BENEFITS COMPARED TO TRADITIONAL CENTRALIZED TREATMENT SYSTEMS: LOWER WATER TEMPERATURE, LOWER ENERGY DEMAND, LOWER MAINTENANCE, LOWER COST, RECREATION AREA, RESOURCE CONSERVATION, HABITAT FOR WILDLIFE AND AQUATIC LIFE, AND ATTRACTIVE AESTHETICS

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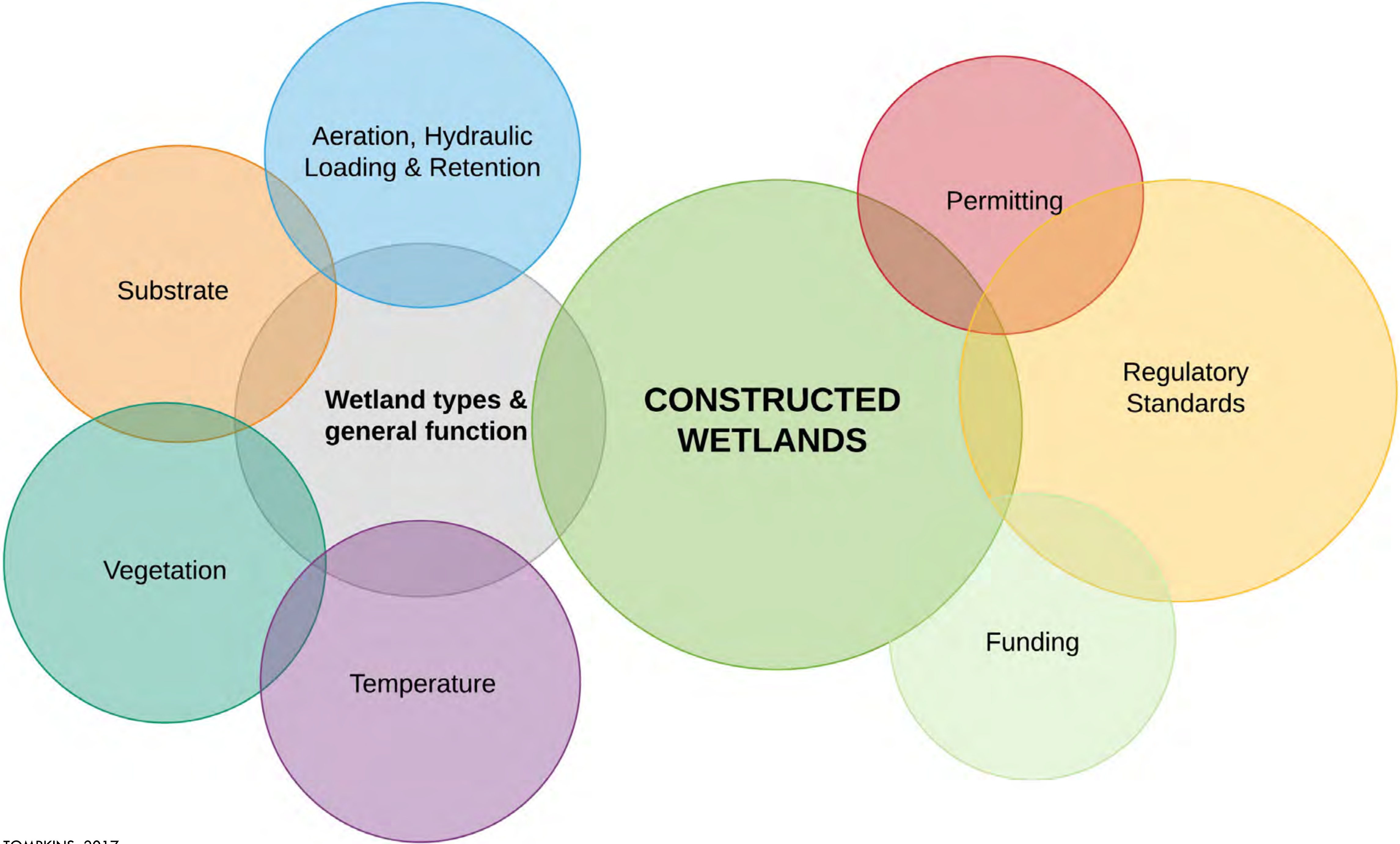


TOMPKINS, 2017.

GENERAL FUNCTION

CONSTRUCTED WETLANDS ARE…

“TREATMENT SYSTEMS THAT USE NATURAL PROCESSES INVOLVING WETLAND VEGETATION, FILTER MEDIA, AND THEIR ASSOCIATED MICROBIAL ASSEMBLAGES TO IMPROVE WATER QUALITY” (US EPA)

A POPULAR METHOD OF WASTEWATER TREATMENT FOR SMALL COMMUNITIES AND REMOTE LOCATIONS AROUND THE WORLD

OPEN SOURCE IMAGES, 2019.

WETLAND TYPES

CATEGORIES BASED ON HYDROLOGY:

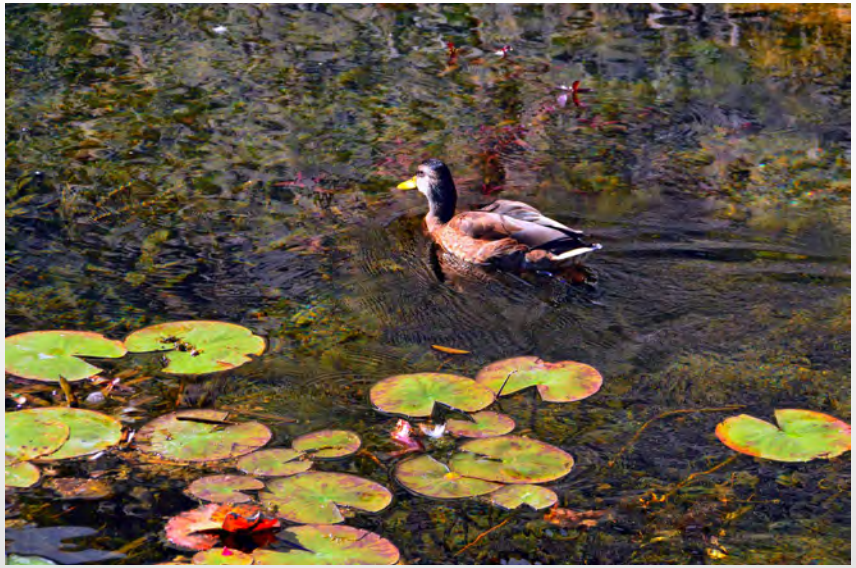
1. FREE WATER SURFACE FLOW (FWS)

2. SUBSURFACE FLOW (SSF)

   * VERTICAL SSF
   * HORIZONTAL SSF

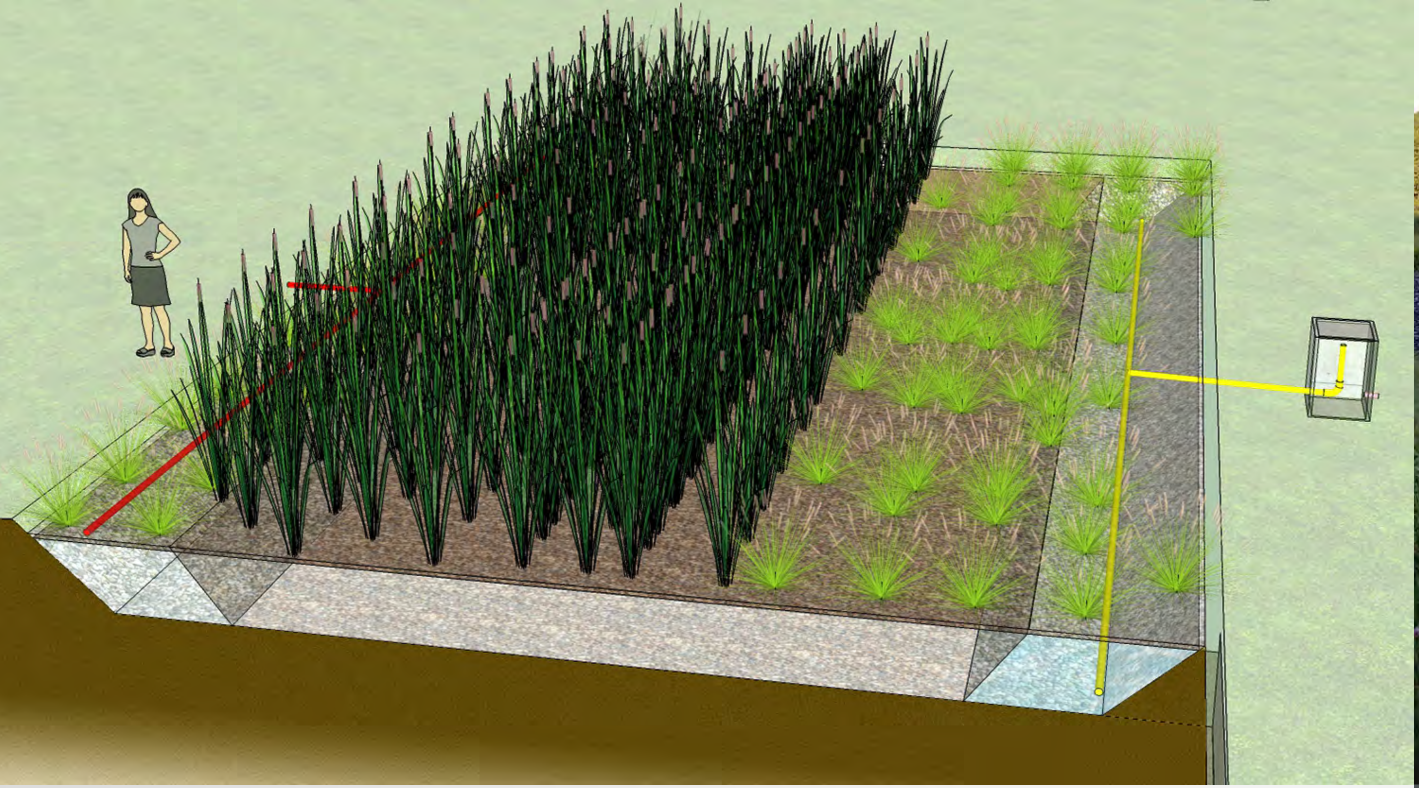
3. HYBRID

FREE WATER SURFACE


OPEN SOURCE IMAGES, 2019.

- SIMILAR IN APPEARANCE TO NATURAL WETLANDS
- SHALLOW DEPTH OF WATER OVER A SATURATED SUBSTRATE
- BENEFITS: ATTRACTIVE, DRAW WILDLIFE, ALLOW HUMAN CONTACT WITH WATER
- DRAWBACKS: SUSCEPTIBLE TO FREEZING, POTENTIAL ODORS AND MOSQUITOS




HORIZONTAL SUBSURFACE FLOW

- WATER FLOWS HORIZONTALLY THROUGH THE SUBSTRATE
- FIRST USED IN GERMANY IN 1974
- NOW USED IN TENS OF THOUSANDS OF EUROPEAN COMMUNITIES
- BENEFITS: LACK OF ODORS, MOSQUITOS, AND MINIMAL RISK OF HUMAN CONTACT
- DRAWBACKS: DESIGN AND MATERIAL SPECS CRITICAL TO PREVENT CLOGGING OF SUBSTRATE/FILTER MEDIA
- SOMEWHAT PREFERENTIAL TO ANAEROBIC (DENITRIFYING) CONDITIONS

VERTICAL SUBSURFACE FLOW

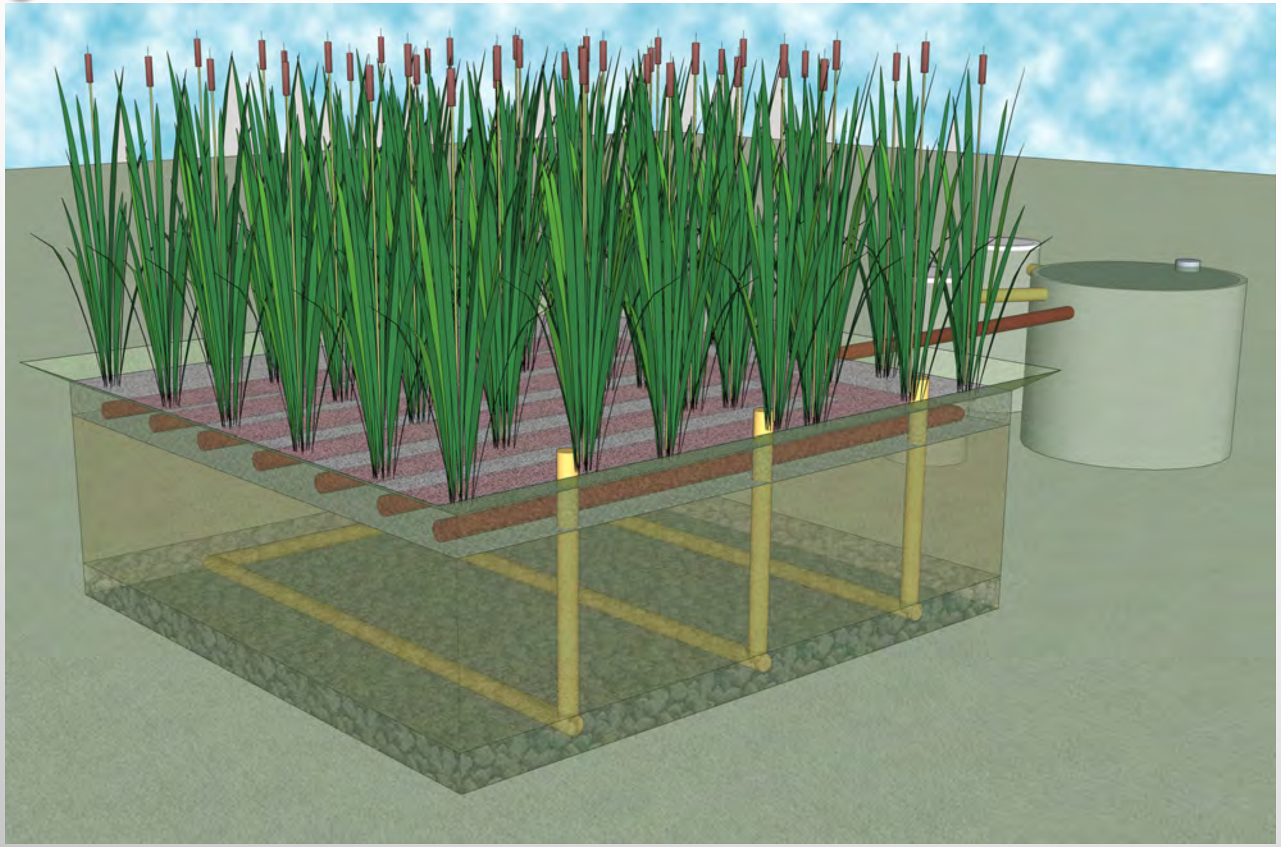


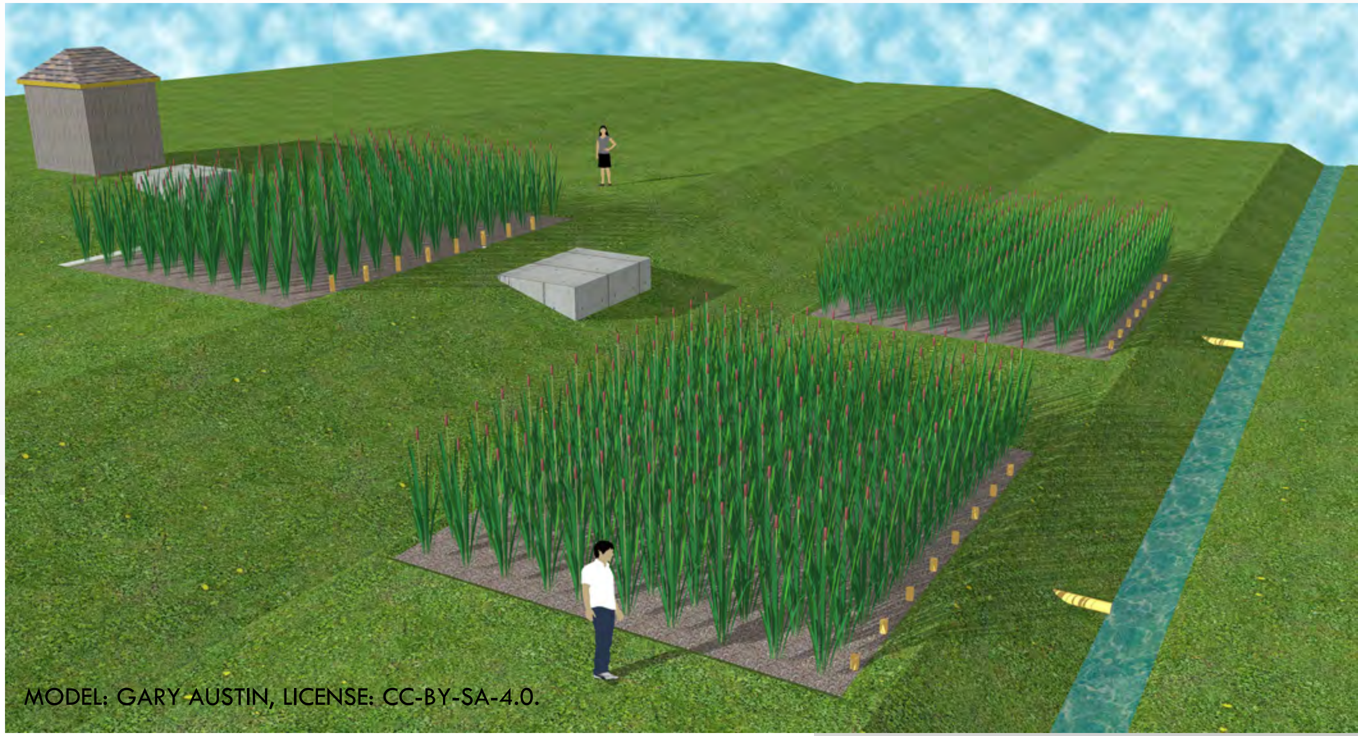
PHOTO & MODEL: GARY AUSTIN, LICENSE: CC-BY-SA-4.0.

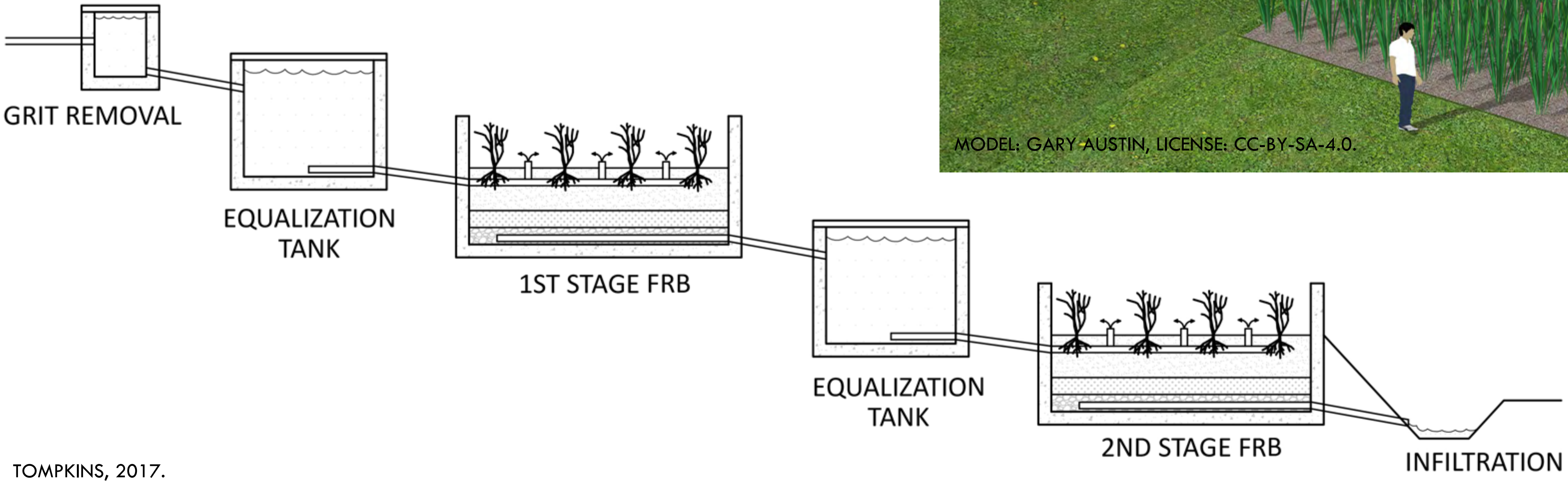
- WATER IS DISTRIBUTED BELOW SURFACE AND FLOWS VERTICALLY THROUGH THE SUBSTRATE
- BENEFITS: REQUIRE LESS AREA THAN FWS WETLANDS, LACK OF ODORS, MOSQUITOS, AND MINIMAL RISK OF HUMAN CONTACT
- FRENCH REED BED DESIGN DOES NOT REQUIRE PRETREATMENT
- SOMEWHAT PREFERENTIAL TO AEROBIC (NITRIFYING) CONDITIONS

VERTICAL SUBSURFACE FLOW

FRENCH REED BEDS

- RECEIVES RAW WASTEWATER
- MINIMAL PRETREATMENT FOR GRIT/OIL REMOVAL
- NO NEED FOR SEPTIC OR IMHOFF TANKS
- SLUDGE REMOVAL FROM 1ST STAGE BEDS EVERY 10+ YRS
- BENEFITS: REDUCED COST RELATED TO PRETREATMENT/SLUDGE HANDLING OVER OTHER SYSTEMS
- DRAWBACKS: POTENTIAL PERMITTING CHALLENGES RELATED TO VECTORING PATHOGENS FROM SURFACE SLUDGE





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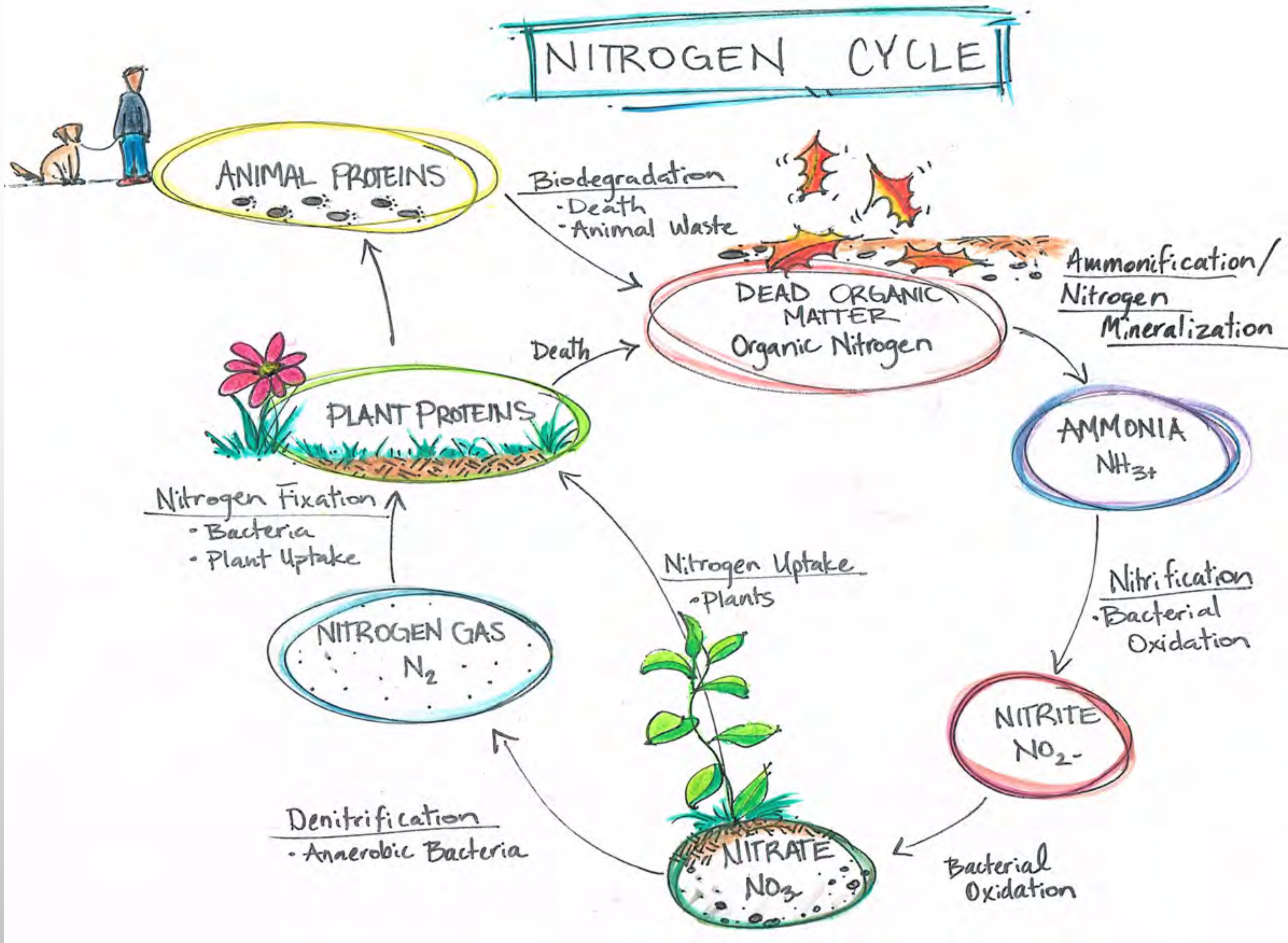
CRITICAL COMPONENTS

AERATION, HYDRAULIC LOADING, & HYDRAULIC RETENTION

- CAN BE MANIPULATED TO CONTROL AEROBIC AND ANAEROBIC CONDITIONS TO PROMOTE AMMONIFICATION, NITRIFICATION, AND DENITRIFICATION
- EXAMPLES: DROP AERATION, FORCED AERATION, TIDAL (FILL & DRAIN) FLOW REGIMES, ETC.



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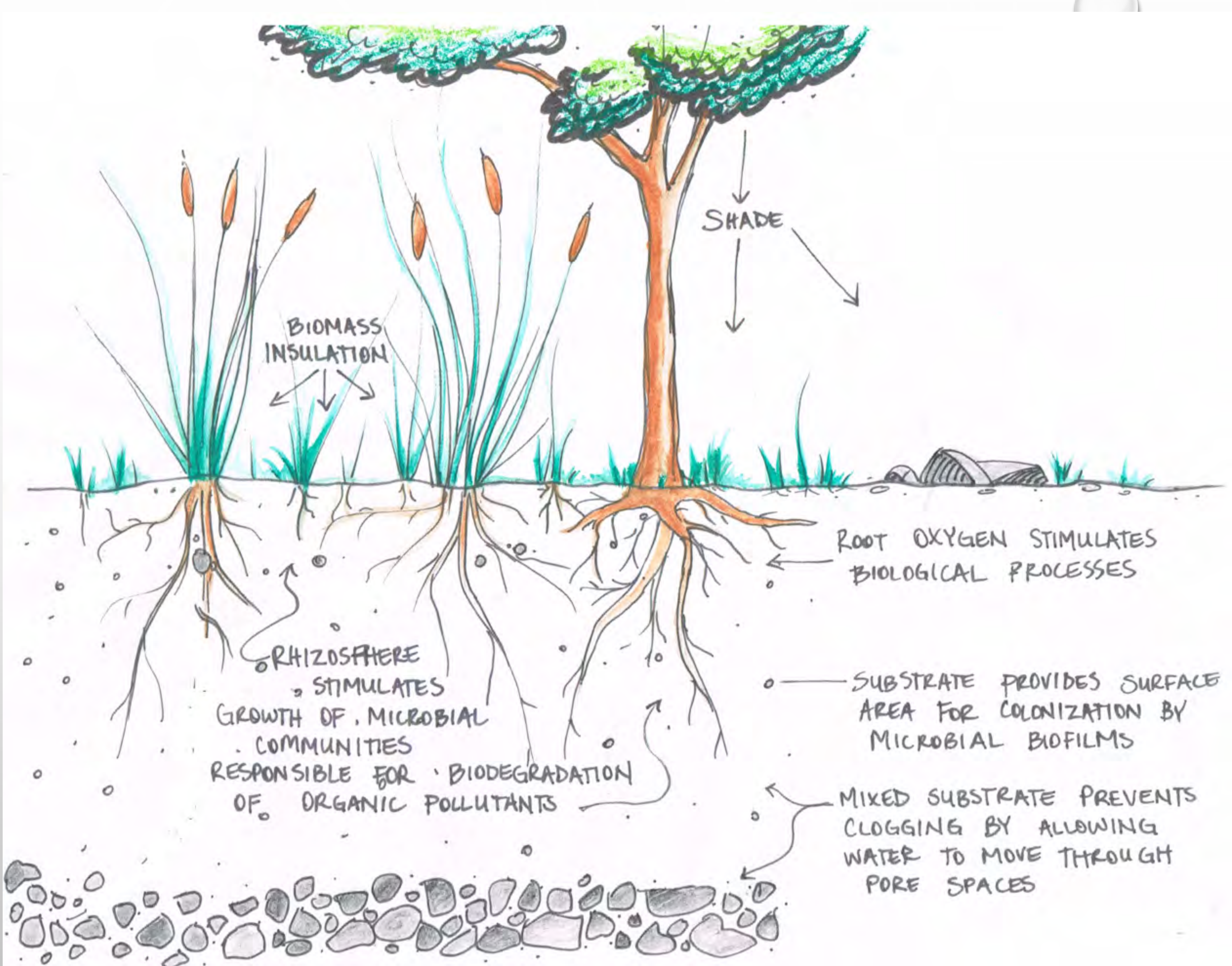
CRITICAL COMPONENTS

PLANTS

- PROVIDE THERMAL PROTECTION AGAINST ICE
- PLANT GROWTH, RESPIRATION, AND NUTRIENT EXCHANGE SUPPORT MICROBES THAT BREAK DOWN POLLUTANTS
- POLY-CULTURE AND COLD-HARDY TRAITS IMPROVE TREATMENT EFFICIENCY

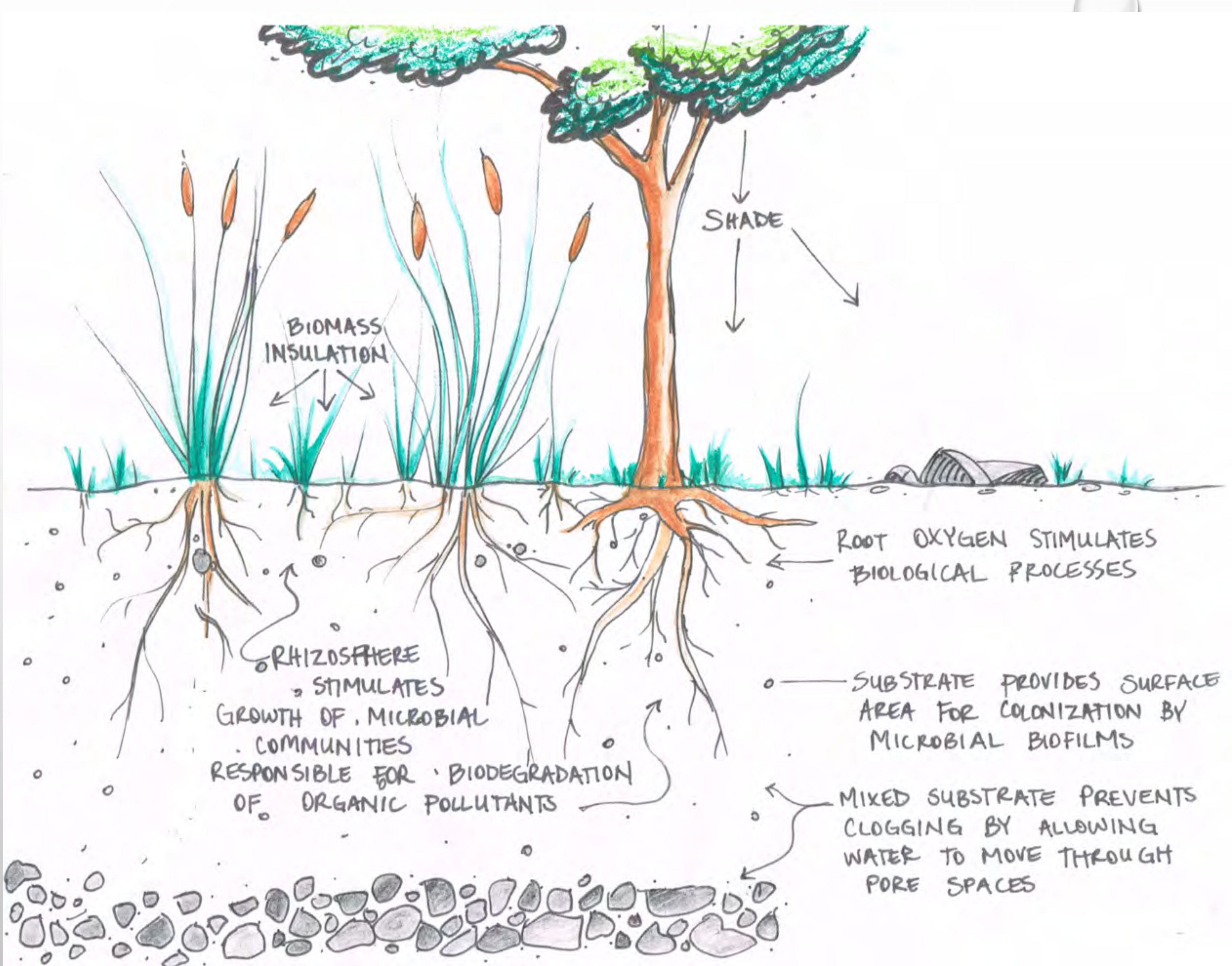


TOMPKINS, 2017.

CRITICAL COMPONENTS

SUBSTRATE

- PROVIDES GROWING MEDIUM FOR PLANT MATERIALS AND MICROBIAL LIFE
- MIXED SUBSTRATES PROVIDE HIGH HYDRAULIC CONDUCTIVITY WHICH HELPS PREVENT CLOGGING
- SPECIFIC SUBSTRATES USED TO TARGET REMOVAL OF SPECIFIC POLLUTANTS



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CRITICAL COMPONENTS

TEMPERATURE

- COLD TEMPERATURES SLOW MICROBIAL PROCESSES/NITRIFICATION AND DENITRIFICATION, BUT CAN STILL PROVIDE EFFECTIVE TREATMENT.
- COLD TEMPS DON'T EFFECT REMOVAL OF PHOSPHOROUS, TSS, BOD, COD
- USE COMMON SENSE: SOUTHERN ASPECTS, BURY PIPING, ALTERNATE FILTERS 2X WEEK
- SSF WETLANDS CAN REDUCE WATER TEMPERATURE

OPEN SOURCE IMAGES, 2019.

CASE STUDY #1

PRINSBURG, MINNESOTA

POPULATION 497

COST $1,281,800 (2004)

+ $30,000/YR CONTRACTED MONITORING, M & O

+ ANNUAL SEPTIC PUMPING

+ PUBLIC WORKS MANAGER

CASE STUDY #1

PRINSBURG, MINNESOTA

- SIZED TO TREAT 54,000 GPD
- GRAVITY CITY SEWER LINES
- PRETREATMENT - (4) 20,000 SEPTIC TANKS
- EVEN DISTRIBUTION TO (4) HORIZONTAL SSF WETLANDS WITH FORCED BED AERATION
- TOTAL SIZE = 1.57 ACRES
- (2) 15,000 G DOSING TANKS FEED (2) VERTICAL SSF SAND FILTERS FOR SECONDARY TREATMENT
- CHLORINATION/ DECHLORINATION PRIOR TO DISCHARGE TO SURFACE WATER

CITY OF PRINSBURG, 2015

CASE STUDY #2

MINOT, NORTH DAKOTA

POPULATION 50,000 (2018)

CONSTRUCTED 1991

MINOT NPDES FACTSHEET, CURRENT.

CITY OF MINOT, 2019.

CASE STUDY #2

MINOT, NORTH DAKOTA

- TREATS 7.5 MILLION GPD
- PERMITTED AS LAGOON FACILITY WITH WASTEWATER STABILIZATION PONDS (I.E. FWS WETLANDS)
- PRIMARY TREATMENT = (2) 8-ACRE AERATION BASINS
- FOLLOWED BY (5) 140-ACRE LAGOON CELLS
- SECONDARY TREATMENT = (4) FWS WETLANDS OCCUPYING 160 ACRES
- WETLAND DEPTH & VEGETATION SPECIFIED TO FACILITATE REMOVAL OF BOD, TSS, NITRIFICATION, DENITRIFICATION, AND NUTRIENT REMOVAL
- FINAL TREATMENT = 2.5 MILE DRAINAGE WAY DISCHARGING TO SURFACE WATER MAY-DECEMBER

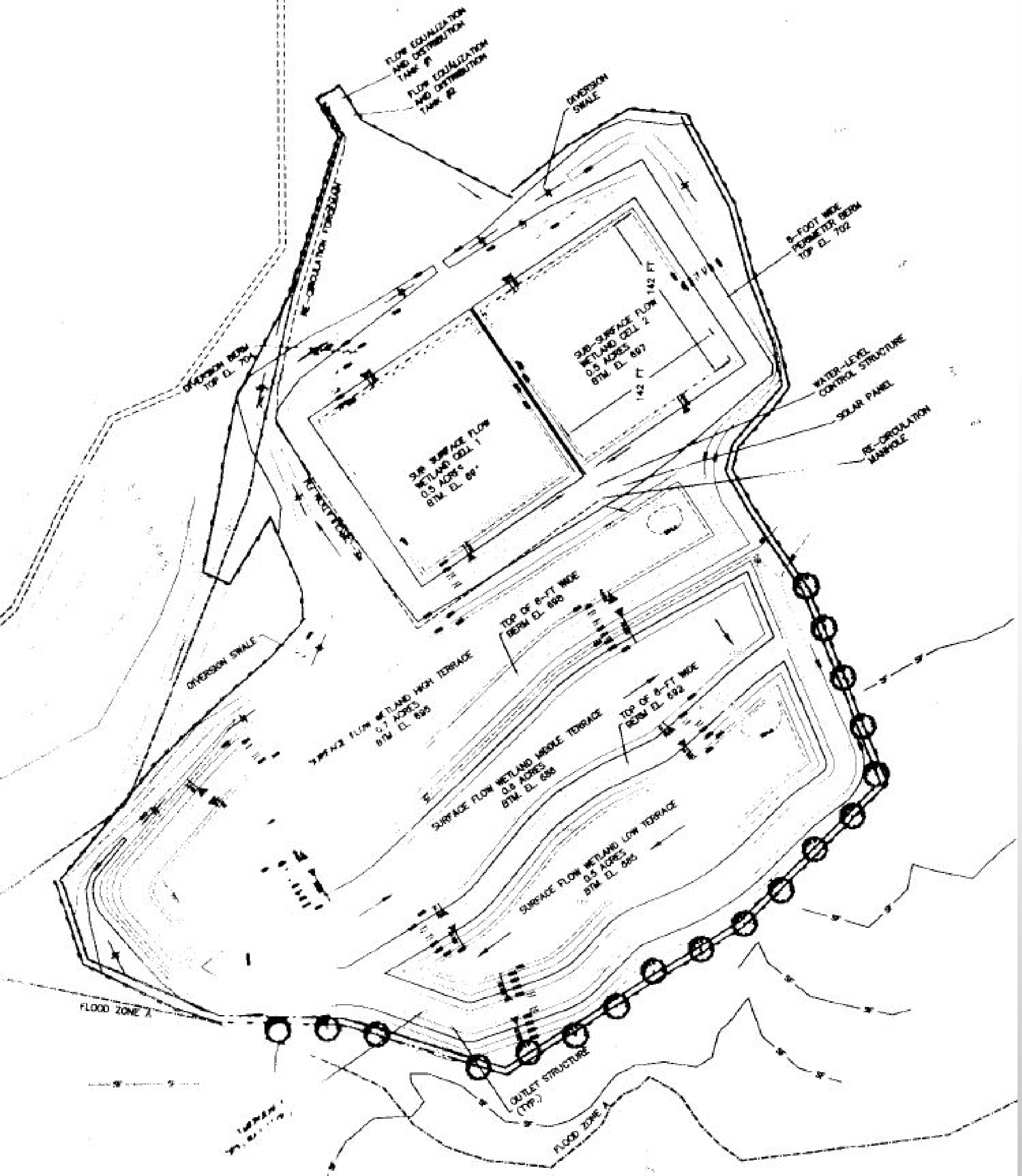
CASE STUDY #3

BOSTON MILLS HISTORIC DISTRICT

CUYAHOGA VALLEY NATIONAL PARK, OHIO

COST $132,500
(2006 FEASIBILITY STUDY)

GOOGLE EARTH, 2018.



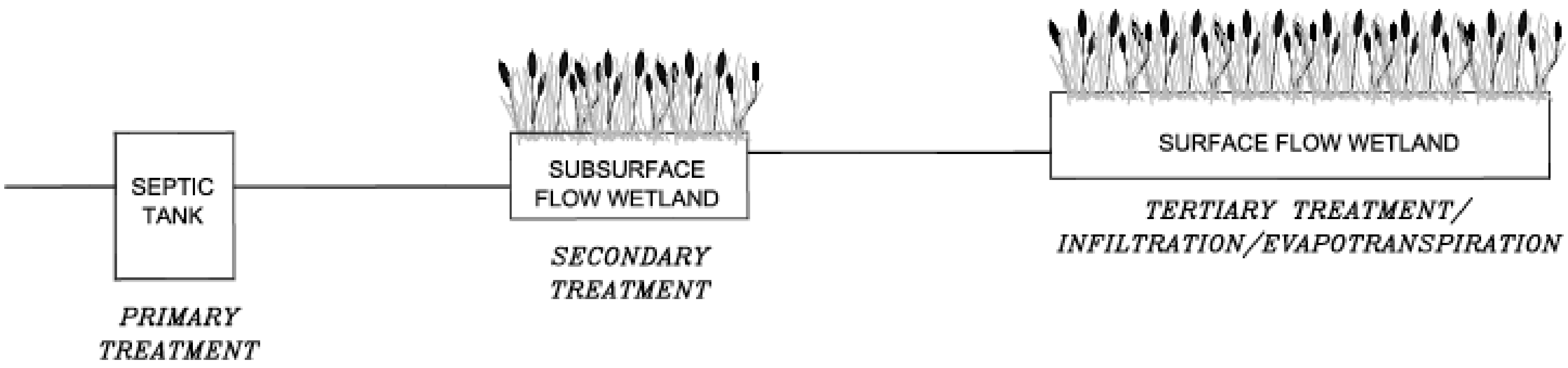
CASE STUDY #3

BOSTON MILLS HISTORIC DISTRICT

- PROVIDES TREATMENT TO 6 STRUCTURES INCLUDING VISITORS CENTER, PUBLIC RESTROOMS, & OFFICES
- DESIGN CAPACITY 4999 GPD
- PRIMARY TREATMENT = SEPTIC TANK
- SECONDARY TREATMENT = SSF WETLAND TO REMOVE BOD AND SMALL SUSPENDED SOLIDS
- THROUGH AEROBIC & ANAEROBIC PROCESSES
- FINAL TREATMENT = FWS WETLAND FOR INFILTRATION & EVAPORATION
- BENEFITS: NO DISCHARGE PERMIT REQUIRED, MAINTAINS NATURAL AESTHETICS IN NATIONAL PARK W/HIGH VISIBILITY FROM HIGHWAYS
- CHALLENGE: AVOIDING 100-YR FLOODPLAIN

URS, 2010.

CONSTRUCTED WETLAND SYSTEM SCHEMATIC



BOSTON MILLS HISTORIC DISTRICT

Figure 5-1

Sanitary Sewer System Feasibility Study

URS

PERMITTING WASTEWATER TREATMENT FACILITIES

AN IDAHO EXAMPLE

PLANNING

- FACILITY PLAN - DEVELOPED BY LICENSED ENGINEER
- MASTER PLANNING DOCUMENT/ENGINEERING REPORT
- COMPREHENSIVE ASSESSMENT OF OPERATIONAL NEEDS & SYSTEM REQUIREMENTS
- REQUIRED TO BE ELIBIGLE FOR STATE GRANT/LOAN FUNDING
- REVIEW & APPROVAL BY DEPARTMENT OF ENVIRONMENTAL QUALITY

ENGINEERING

- PRELIMINARY ENGINEERING REPORT
- COMPLETED BY COMMUNITY'S ENGINEER
- INCLUDES PLANS AND SPECS FOR PROPOSED TREATMENT SYSTEM
- REVIEW & APPROVAL BY DEPARTMENT OF ENVIRONMENTAL QUALITY

PERMITTING

- COMMUNITY REQUESTS MODIFICATION OF AN EXISTING DISPOSAL PERMIT, OR…
- APPLY FOR A NEW PERMIT
- MAY BE A DISCHARGE AND/OR REUSE PERMIT
- APPROVAL REQUIRED PRIOR TO IMPLEMENTATION OF SYSTEM

WATER QUALITY STANDARDS

Parameter	30-Day Average	7-Day Average
BOD_5	30 mg L^{-1}	45 mg L^{-1}
TSS	30 mg L^{-1}	45 mg L^{-1}
BOD_5 and TSS Removal	85% minimum	---
pH	Between 6.0 and 9.0 standard units	

FEDERAL SECONDARY TREATMENT STANDARDS (40 40 CFR 133.102 CFR 133.102) UNDER THE CLEAN WATER ACT

2018 NPDES PERMIT LIMITATIONS AND MONITORING REQUIREMENTS FOR JULIAETTA, IDAHO
(EXCLUDING WATER TEMPERATURE WHICH IS LISTED SEPARATELY)

Parameter	Units	Effluent Limitations			Monitoring Requirements		
		Average Monthly	Average Weekly	Maximum Daily	Sample Location	Sample Frequency	Sample Type
Parameters with Effluent Limits							
BOD_5	mg L^{-1}	30	45	---	Influent and Effluent	1 $month^{-1}$	Grab
	lb d^{-1}	20	30	---			Calculation
BOD_5 % Removal	%	85 minimum	---	---	---	1 $month^{-1}$	Calculation
TSS	mg L^{-1}	30	45	---	Influent and Effluent	2 $month^{-1}$	Grab
	lb d^{-1}	18	30	---			Calculation
TSS % Removal	%	85 minimum	---	---	---	1 $month^{-1}$	Calculation
E. coli	cfu ml^{-100}	126	---	406 instant. maximum	Effluent	5 $month^{-1}$	Grab
	µg L^{-1}	12	---	21	Effluent	1 $month^{-1}$	Grab

5 BENEFICIAL USES OF WATER

IDAHO ADMINISTRATIVE CODE (IDAPA 58.01.02.100) DEFINES 5 BENEFICIAL USES OF WATER

- SUPPORT AQUATIC LIFE
- PROVIDE RECREATION AREA
- MAINTAIN A SUSTAINABLE WATER SUPPLY
- PROVIDE WILDLIFE HABITAT
- IMPROVE AESTHETICS

5 BENEFICIAL USES OF WATER

- DO NOT QUALIFY AS "BENEFICIAL USES" WHILE WATER IS HELD IN A PRIVATE TREATMENT SYSTEM
- BUT BENEFITS ARE ACKNOWLEDGED BY REGULATORY AGENCIES
- RECEIVING WATERS ARE POSITIVELY IMPACTED

OPEN SOURCE IMAGES, 2019.

UNLIKE MECHANICAL TREATMENT SYSTEMS

→

CONSTRUCTED WETLANDS CAN PROVIDE BENEFITS WHILE WATER IS IN THE TREATMENT SYSTEM

TOMPKINS, 2017.

PERMITTING CHALLENGES

- NO CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT IN IDAHO, CREATING UNCERTAINTY IN PERMITTING
- METHOD OF TREATMENT IS INCLUDED IN THE FACILITY PLAN AT THE DISCRETION OF THE CONTRACT ENGINEER OR AT THE COMMUNITY'S REQUEST
- TECHNICALLY (BY THE BOOK) THERE ARE NO INCENTIVES FOR CONSTRUCTED WETLANDS, ONLY FOR EFFECTIVE TREATMENT METHODS, HOWEVER…
- THE REALITY THAT WETLANDS PROVIDE THE 5 BENEFICIAL USES OF WATER IS RECOGNIZED BY REGULATORY AGENCIES
- THEIR ABILITY TO LOWER WATER TEMPERATURE IS NOT WELL-KNOWN
- THEIR LOW-COST COMPARED TO TRADITIONAL METHODS IS NOT WELL-KNOWN

FUNDING CONSTRUCTED WETLANDS

TOTAL COSTS INCLUDE:

- CONSTRUCTION & INSTALLATION
  - MATERIALS
  - LABOR & SITEWORK
- OPERATIONS, MAINTENANCE, MONITORING
- DEPRECIATION OVER LIFETIME OF SYSTEM
- SIZE & COMPLEXITY

LOW MAINTENANCE CAN TRANSLATE TO LARGE SAVINGS OVER THE LIFETIME OF A SYSTEM

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FUNDING CONSTRUCTED WETLANDS

<u>EXAMPLE</u>:
COST FOR A FRENCH REED BED SYSTEM IN ITALY (2014-2016) WAS STUDIED FOR A 500-1000 POPULATION EQUIVALENT (SIMILAR IN SIZE TO JULIAETTA)

NEW CONSTRUCTION WAS 364 EUROS ($417 US) PER PE

= $417,000 US FOR A SYSTEM WITH 1000 PE TREATMENT CAPACITY

AVERAGE ANNUAL O & M COST OF 5531 EUROS/YEAR ($6340 US) FOR ENERGY & LABOR (REED HARVESTING, INSPECTIONS, & MONITORING)

PRIMARY O & M COST OF FRENCH REED BEDS IS COMPARATIVELY LESS THAN OTHER WETLAND SYSTEMS DUE TO REDUCED SLUDGE MANAGEMENT NEEDS

OPEN SOURCE IMAGES, 2019.

FUNDING PROGRAMS

FOR WASTEWATER SYSTEMS

Agency	Idaho Department of Commerce	Idaho Department of Environmental Quality	National Rural Water Association	U.S. Army Corps of Engineers	U.S. Department of Agriculture - Rural Development
Program	Community Development Block Grant	Wastewater Planning Grant; State Revolving Fund Low Interest Construction Loan	Rural Water Loan Fund	Section 595 Program - Environmental Infrastructure	Technical Assistance & Training (TAT) - Water & Waste Direct Loans & Grants
Purpose	Public facilities construction and improvements - sewer, water, etc.	Facility Planning & Construction	Water/Wastewater Project pre-development and small capital projects	Rural Water/Wastewater Improvements	Broad - construction, improvements, relocation, connections, land acquisition
Eligibility	> or = 51% Low-Moderate Income Communities	Public entities and non-profits	Public entities and non-profits, rural communities up to 10,000	Nevada, Montana, Idaho; <10,000 preferred	Rural communities up to 10,000 population
Grantor/Community Match	At least 50/50 to be competitive	50/50 planning; 100% construction	Maximum $100,000 or 75% of total project cost	75/25	Grant - none; 45/55 Loan

OPEN SOURCE IMAGES, 2019.

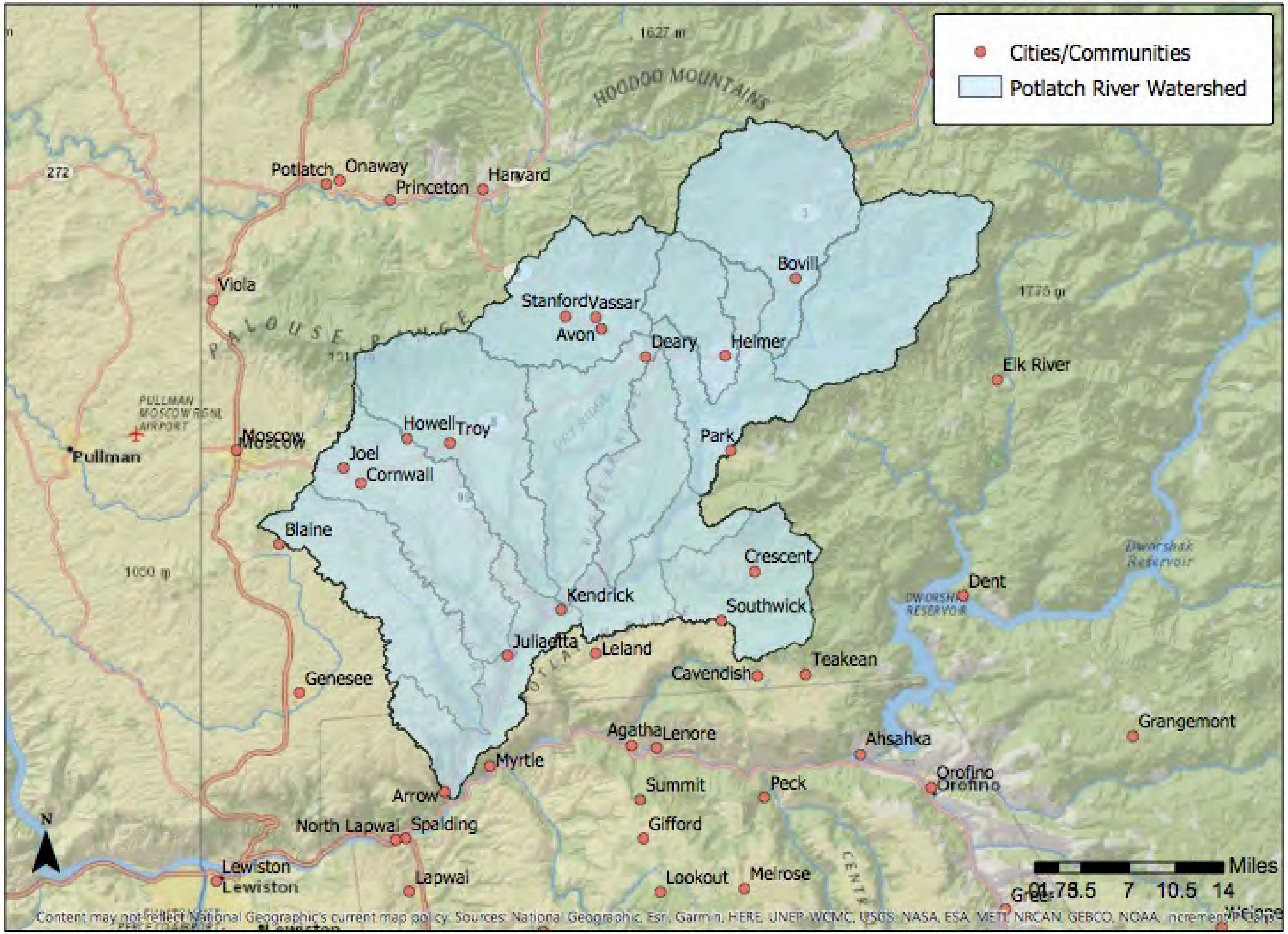
GENERAL CHALLENGES

- PUBLIC ACCEPTANCE – THEY CAN'T SUPPORT WHAT THEY DON'T KNOW
- ENGINEERING – THEY CAN'T DESIGN WHAT WON'T GET PERMITTED BY DEQ
- PERMITTING – THEY CAN'T PERMIT WHAT ISN'T ENGINEERED BEYOND ALL DOUBT THAT THE PUBLIC HEALTH, SAFETY, AND WELFARE ISN'T AT RISK

CASE STUDY:
JULIAETTA, IDAHO
IN THE
POTLATCH RIVER WATERSHED

- 380,400 ACRES
- LAND USES
  - FORESTRY
  - LIVESTOCK
  - AGRICULTURE
  - RURAL RESIDENTIAL
  - COMMERCIAL
  - INDUSTRIAL
  - UNDEVELOPED
- POLLUTANTS
  - BACTERIA
  - DISSOLVED OXYGEN
  - AMMONIA
  - NUTRIENTS
  - OIL & GREASE
  - ORGANICS
  - PESTICIDES
  - SEDIMENT
  - TEMPERATURE
- SALMON SPAWNING HABITAT

Potlatch River Watershed



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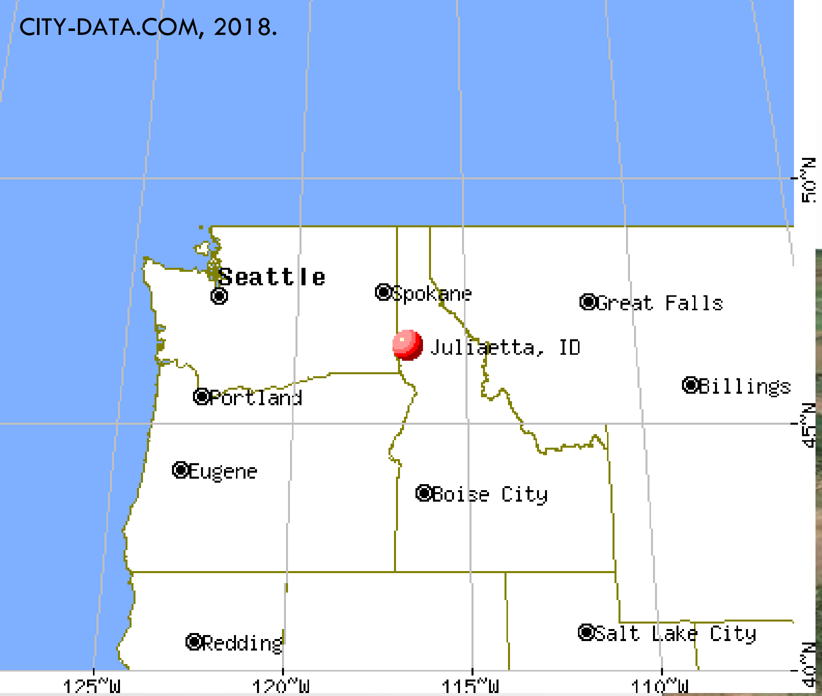


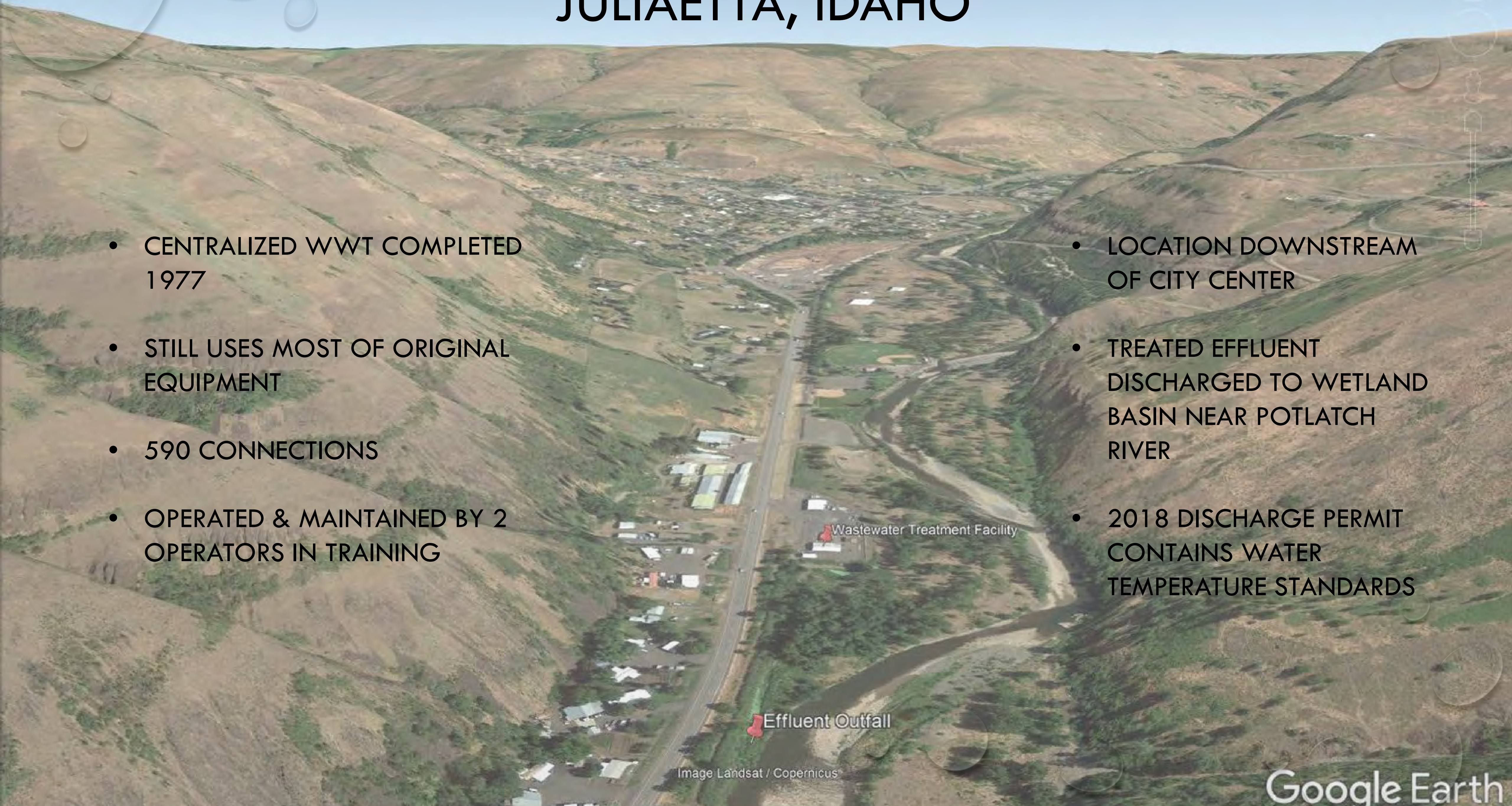
JULIAETTA, IDAHO

- POPULATION 609 (STABLE)
- AVE. TEMPERATURES
  - 28° F WINTER
  - 88° F SUMMER
- ELEVATION 1155 FT
- 18 INCHES ANNUAL PRECIP.
- HARDINESS ZONE 7A
- HEAT ZONE 3

JULIAETTA, IDAHO

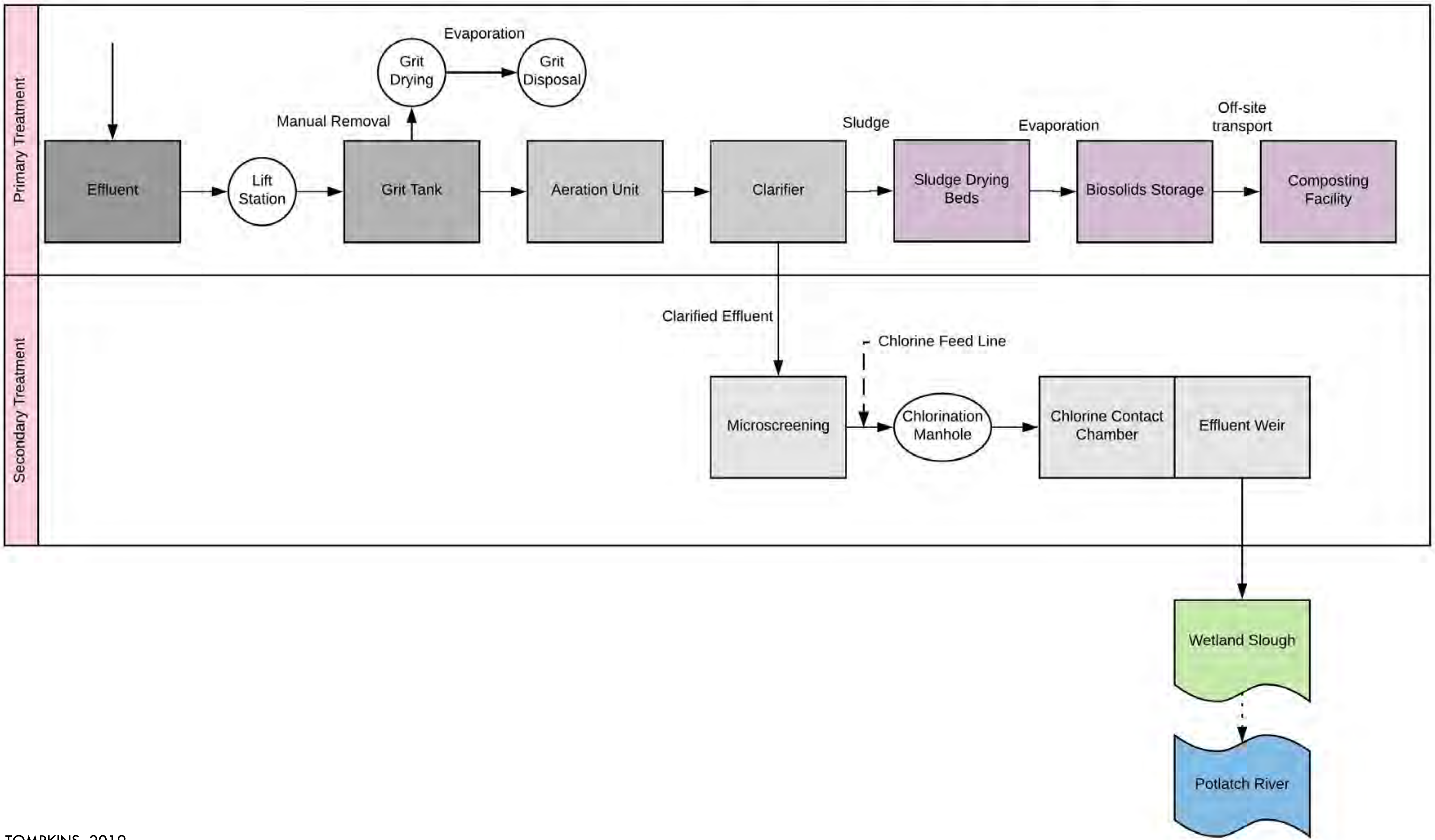
- CENTRALIZED WWT COMPLETED 1977
- STILL USES MOST OF ORIGINAL EQUIPMENT
- 590 CONNECTIONS
- OPERATED & MAINTAINED BY 2 OPERATORS IN TRAINING

- LOCATION DOWNSTREAM OF CITY CENTER
- TREATED EFFLUENT DISCHARGED TO WETLAND BASIN NEAR POTLATCH RIVER
- 2018 DISCHARGE PERMIT CONTAINS WATER TEMPERATURE STANDARDS



EXISTING WASTEWATER OUTFALL

Existing Mechanical Wastewater Treatment System, Juliaetta, ID



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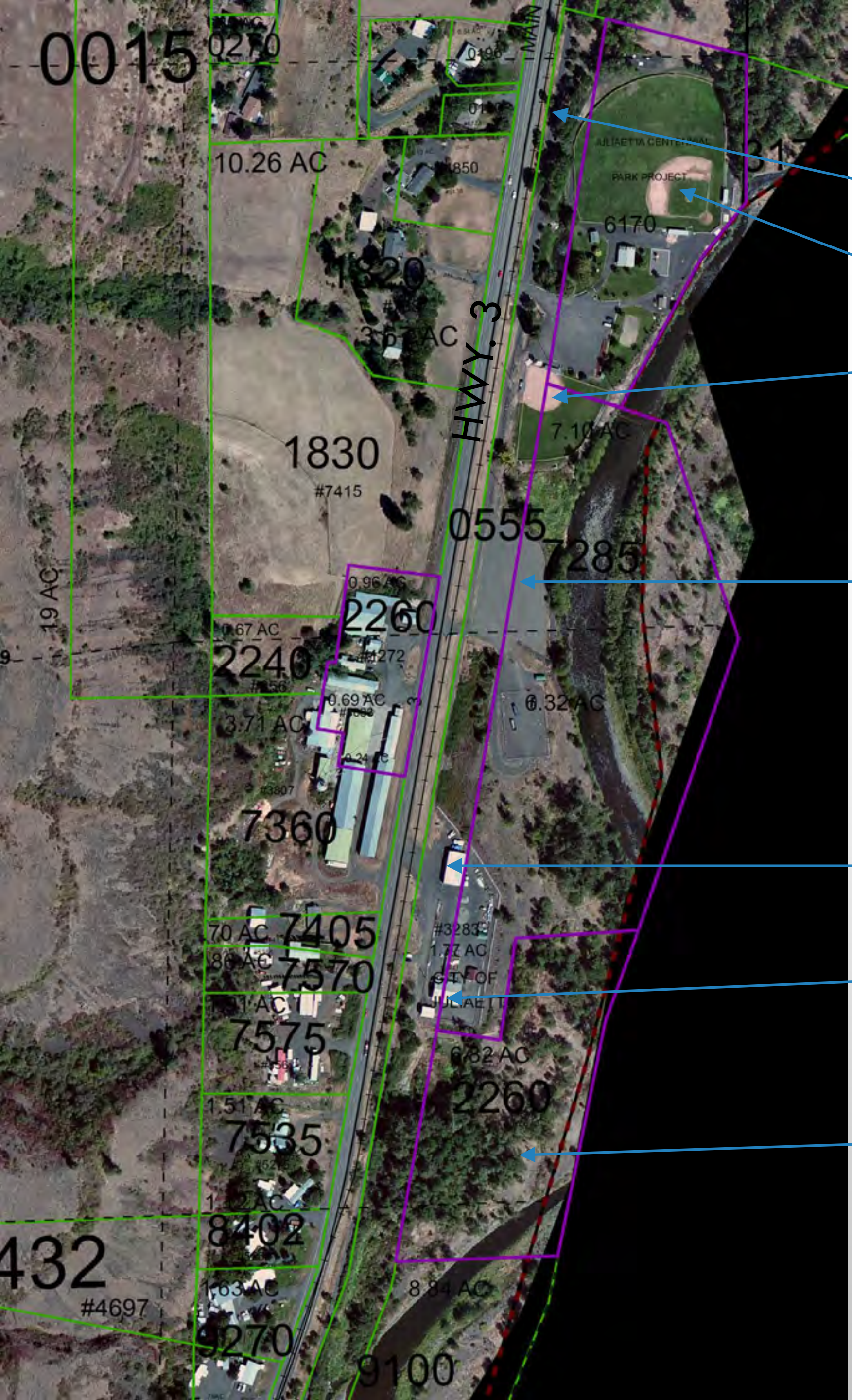
PROJECT VICINITY



PAVED REC PATH (OLD RAILROAD BED)

CENTENNIAL PARK – CITY PARK WITH BASEBALL & SOFTBALL FIELDS, PARKING, AND COVERED PICNIC AREA

CITY PROPERTY & GRAVEL PARKING/STORAGE AREA

VOLUNTEER FIRE STATION

EXISTING WASTEWATER TREATMENT FACILITY

100-YEAR FLOODPLAIN

LATAH COUNTY ASSESSORS OFFICE, 2018.

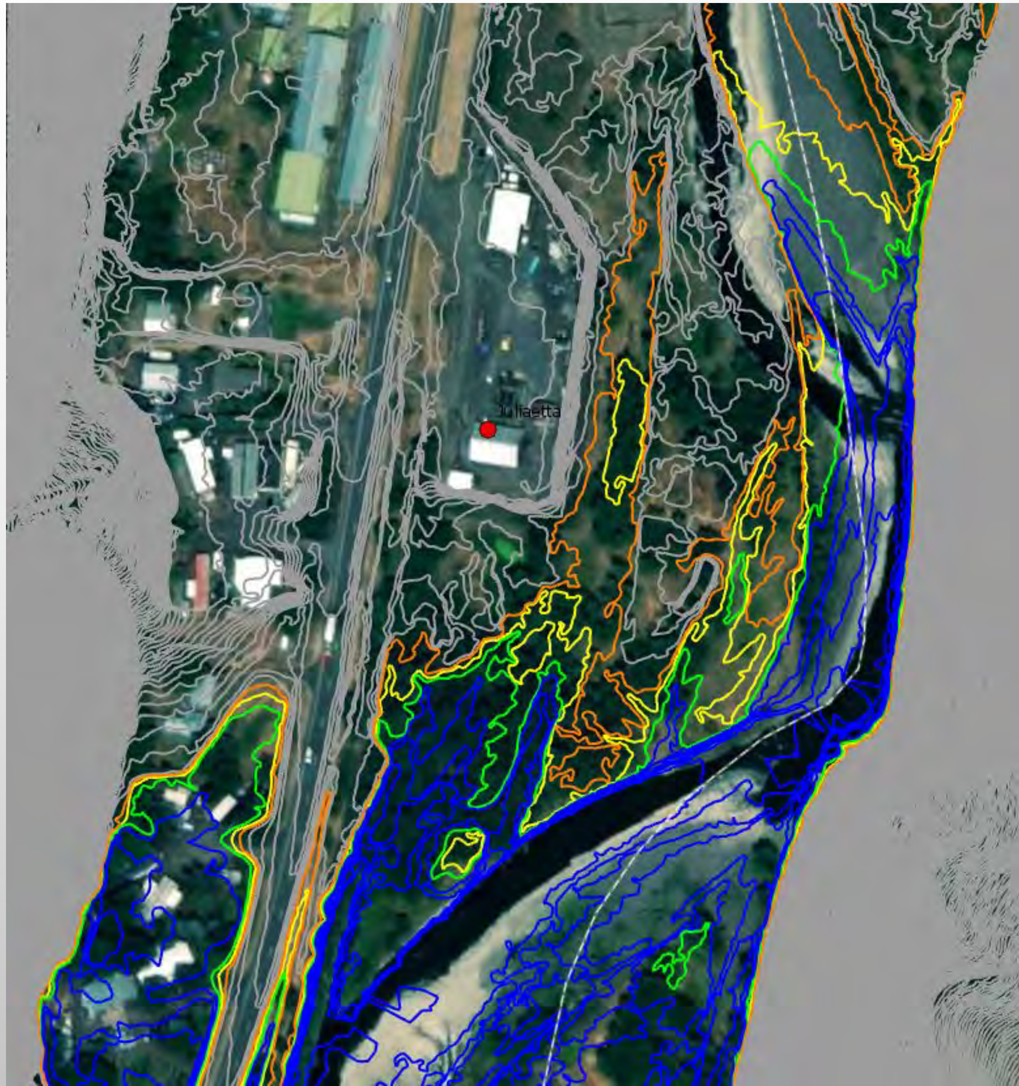
FLOODPLAIN ANALYSIS

TOMPKINS, 2019.

1970'S DATA

VS.

2016 LIDAR DATA



TOMPKINS, 2019.

- FEMA FIRM MAPS NOT HELPFUL IN DETERMINING FLOODPLAIN
- FIRM FLOOD ELEVATION (1038) USED WITH CURRENT ELEVATION DATA TO INTERPOLATE 100-YEAR FLOODPLAIN
- SOILS = AQUIC XEROFLUVENTS
- SHALLOW DEPTH (18-24") TO WATER TABLE
- FROST DEPTH = 24"

LEWIS-CLARK VALLEY
AMERICAN VITICULTURAL AREA

- HILLSIDES DOWNRIVER NOW FLOURISHING WITH VINEYARDS
- POTENTIAL FUTURE REUSE FOR IRRIGATION
- ADVANTAGE OF PLANT AVAILABLE NITROGEN
- REDUCE SURFACE WATER DEMAND FOR IRRIGATION

- PAVED REC PATH (ABANDONED RAILROAD BED) STOPS @ PARK
- PATH CONNECTS TO WWT SITE
- COULD EXTEND RECREATIONAL USE SOUTH BY PAVING PATH
- PARK IS LOCATED UPHILL FROM WWT FACILITY
- POTENTIAL REUSE TO IRRIGATE BALL FIELDS, BUT $$$ TO PUMP UPHILL
- IRRIGATION/REUSE BENEFITS
  + PLANT AVAILABLE NITROGEN
  + REDUCES SURFACE WATER DEMANDS

TOMPKINS, 2019.

TOMPKINS, 2019.

- JULIAETTA VOLUNTEER FIRE STATION IS LOCATED ADJACENT TO WWT FACILITY
- PRESENTS AN OPPORTUNITY FOR PARTIAL WATER REUSE VS. DISCHARGE TO SURFACE WATER BODY (POTLATCH RIVER)

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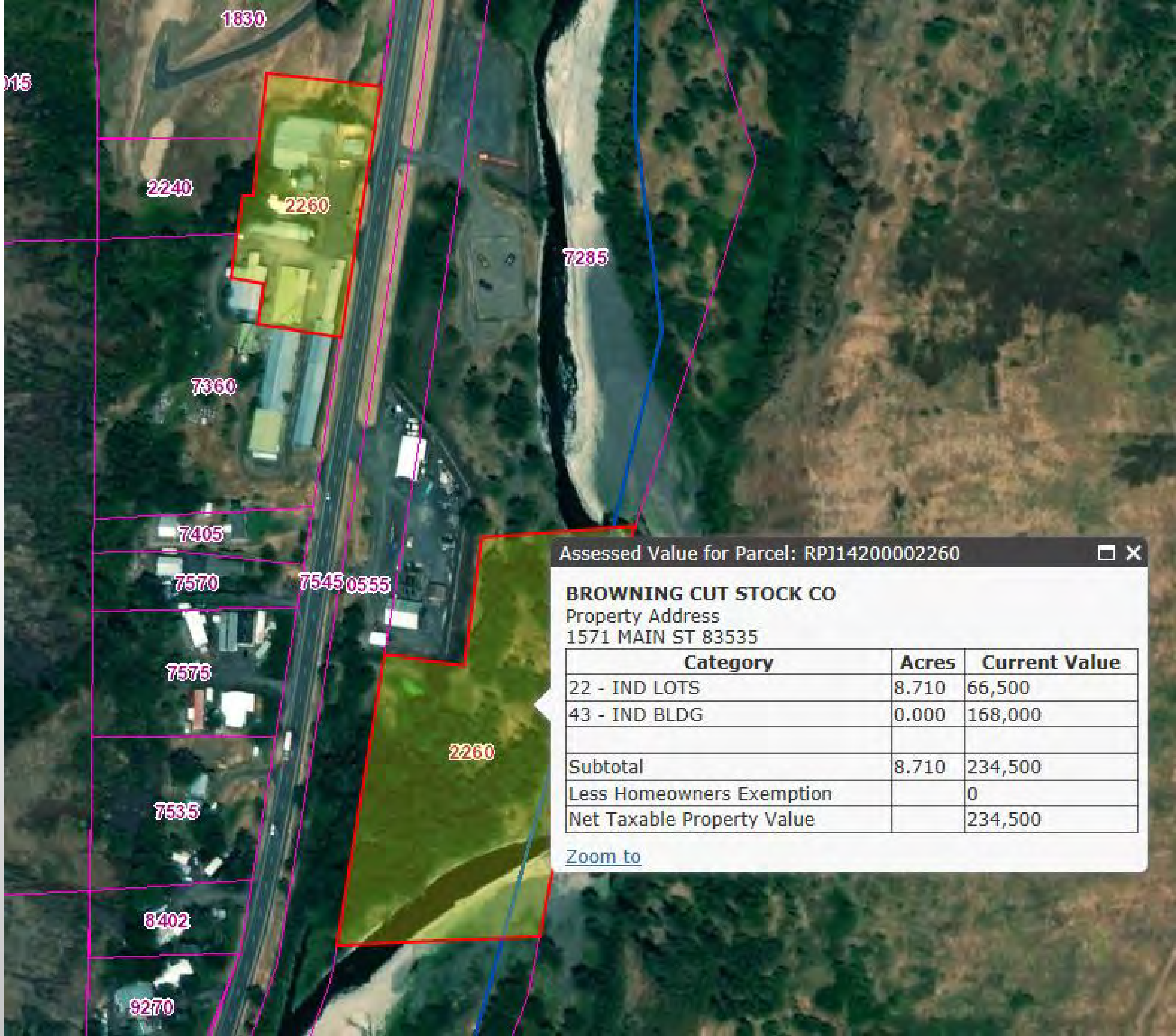
ADJACENT PROPERTY

- OUTFALL AND INFILTRATION CHANNEL MAY NOT BE OWNED BY JULIAETTA
- SURVEY NECESSARY TO LOCATE PROPERTY CORNERS
- 5.6 ADJACENT ACRES
- $300-$1000/ACRE
- $1680-$5600 TOTAL ASSESSED VALUE
- OPPORTUNITY FOR MUTUALLY BENEFICIAL LAND ACQUISITION



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Wetland Types	Aeration, HLR, HRT	Plants	Substrate	Temperature
Surface Flow – best for secondary or tertiary treatment	Topography can be used to facilitate drop aeration	Polycultures provide higher treatment efficiencies than monocultures	Lightweight, mixed aggregates reduce clogging	Cold temperatures slow microbial processes
Horizontal Subsurface Flow – preferential for anaerobic conditions	Batch feeding can be used to control aeration and saturation	Polycultures provide better thermal insulation than monocultures	Mixed substrates provide surface area for microbial attachment	Cold temperatures can affect nitrogen removal at high HLR
Vertical Subsurface Flow – preferential for aerobic conditions	Low HLR increases treatment efficiency	Cold-tolerant plants support cold-tolerant bacteria and increase treatment efficiency	High adsorption substrates facilitate phosphorous removal	Prolonging HRT during cold temperatures increases treatment efficiencies
Vertical French Reed Bed – can be used for primary treatment	Low HRT increases aerobic conditions/nitrification	Roots and rhizomes stimulate growth and oxygenation of microbial communities essential to wastewater treatment	---	Sludge provides insulation and can prevent filter freezing, mulches can be problematic and should be used with caution
Hybrid System– eliminates limitations of a single system	High HRT increases anaerobic conditions/denitrification	Surface vegetation provides thermal insulation against ice formations	---	Site aspect, subsurface piping, and alternating filters can reduce temperature losses

DESIGN CONCLUSIONS

- CONSTRUCTED WETLANDS CAN EFFECTIVELY TREAT WASTEWATER IN ALL CLIMATES AND THE FRENCH REED BED IS THE MOST COST EFFICIENT SYSTEM DUE TO REDUCED SLUDGE MANAGEMENT
- VERTICAL AND HORIZONTAL SSF WETLANDS CAN ALSO BE USED TOGETHER TO OVERCOME SITE CONSTRAINTS
- CRITICAL ELEMENTS MUST BE SPECIFIED TO MAXIMIZE TREATMENT EFFICIENCY
- SOME REGULATORY AGENCIES ARE IDEALLY POSITIONED TO INCENTIVIZE TREATMENT WETLANDS BECAUSE THEY ARE ALSO A FUNDING SOURCE (LIKE IDAHO DEQ)

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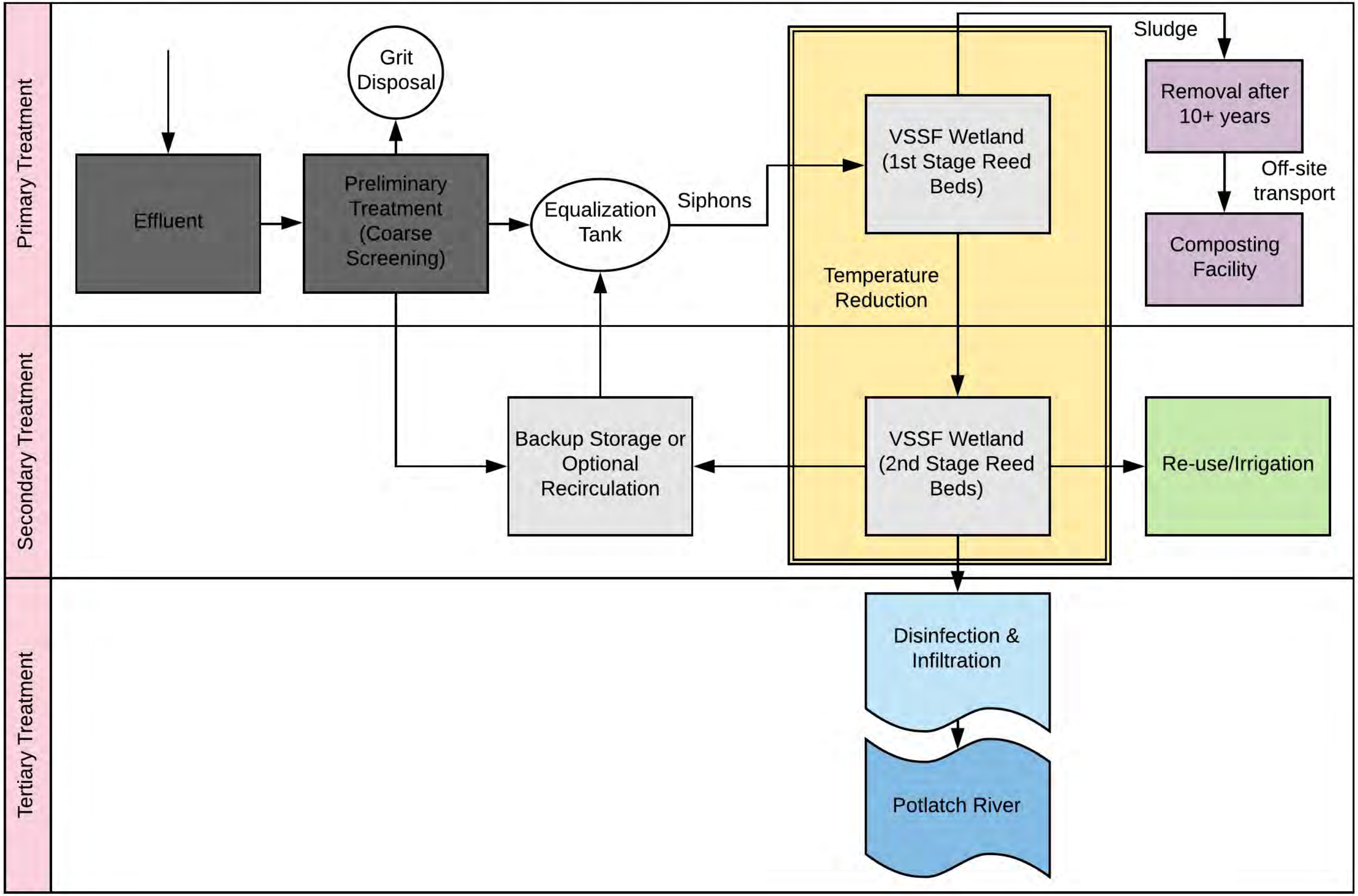
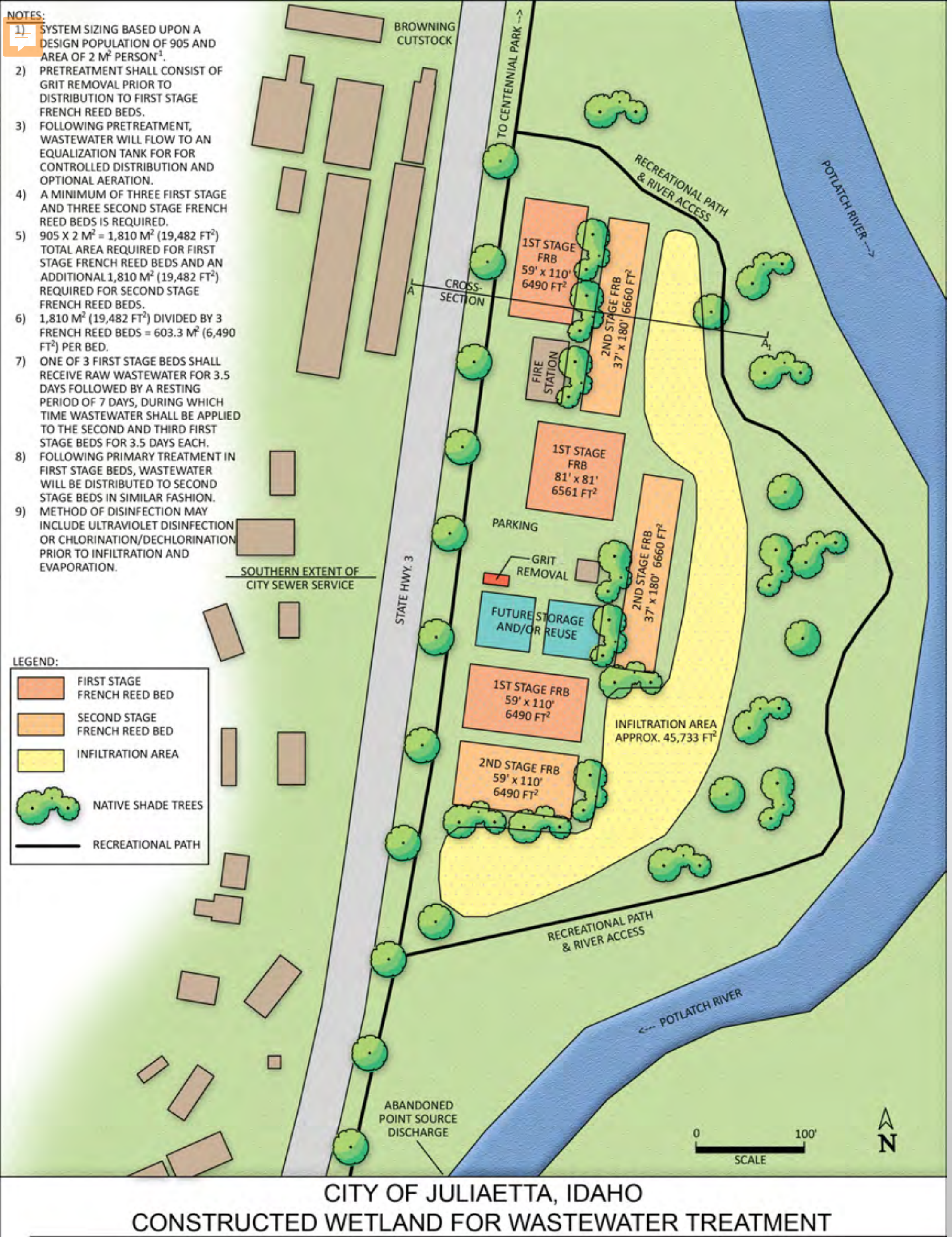
DESIGN CONCLUSIONS

Native Perennial Wetland Grasses, Reeds, and Sedges	
Botanical Name	**Common Name**
Carex amplifolia	Bigleaf Sedge
Carex aquitilis	Water Sedge
Carex lanuginosa	Wooly Sedge
Carex lenticularis	Lens Sedge
Carex microptera	Small-winged Sedge
Carex nebrascensis	Nebraska Sedge
Carex obnupta	Slough Sedge
Carex simulata	Shortbeaked Sedge
Carex utriculata	Beaked Sedge
Carex vesicaria	Inflated Sedge
Eleocharis palustris	Creeping Spikerush
Juncus articulatus	Jointed Rush
Juncus balticus	Baltic Rush
Juncus effuses	Common Rush
Juncus ensifolius	Dagger-leaf Rush
Juncus tenuis	Slender Rush
Scirpus acutus	Hardstem Bulrush
Scirpus cyperinus	Woolgrass
Scirpus microcarpus	Small Fruited Bulrush
Scirpus pungens	Three-square Bulrush
Scirpus validus	Softstem Bulrush
Typha latifolia	Common Cattail

- CONSTRUCTED WETLANDS ARE CHEAPER THAN TRADITIONAL SYSTEMS AND MULTIPLE FUNDING SOURCES CAN BE LEVERAGED TOGETHER
- PERMITTING REQUIRES GOOD COMMUNICATION BETWEEN ENGINEER, COMMUNITY, AND REGULATORY AGENCIES
- REQUIRES A DESIGN TEAM WILLING TO CONSIDER THIS “NEW” TECHNOLOGY
- ADDITIONAL RESEARCH SHOULD INVESTIGATE THE USE OF NATIVE PLANTS AS AN ALTERNATIVE TO INVASIVE AND NON-NATIVE SPECIES

Proposed Constructed Wastewater Treatment Wetland, Juliaetta, ID



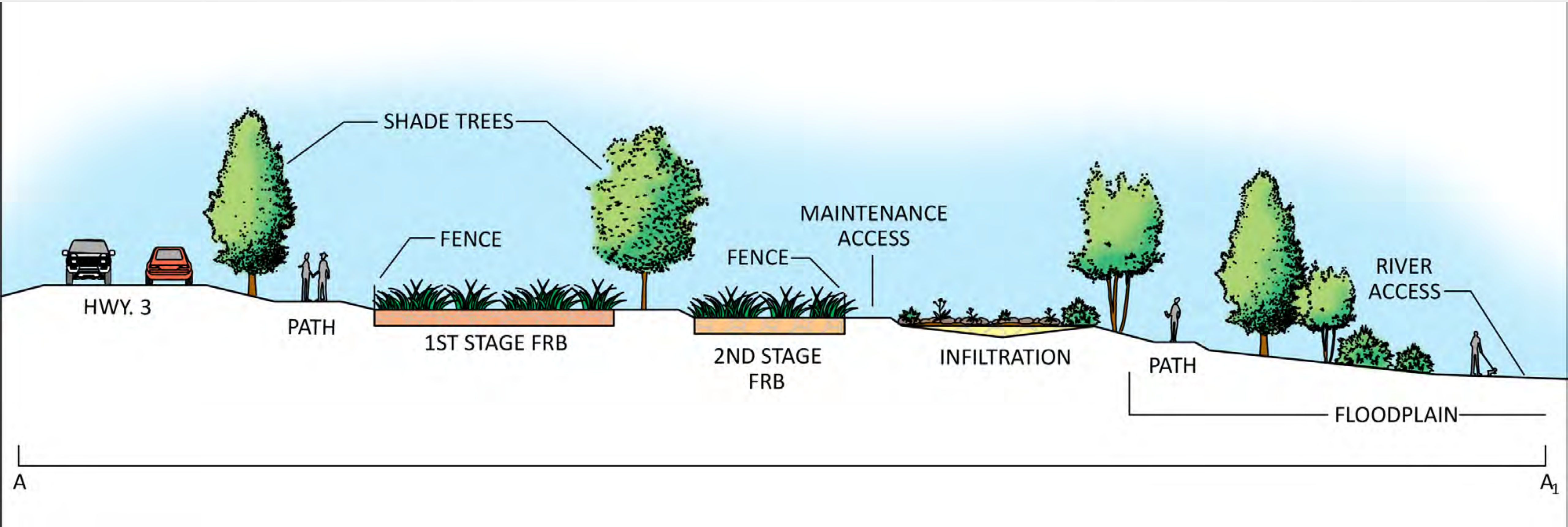


FINAL DESIGN

- FRENCH REED BED METHOD IS THE MOST COST-EFFECTIVE TREATMENT SYSTEM
- FENCING REQUIRED TO PREVENT DIRECT CONTACT RECREATION IN REED BEDS
- CAN BE INCORPORATED INTO A LANDSCAPE WITH RECREATIONAL PATHS, BENCHES, AND WILDLIFE HABITAT
- SUFFICIENT GRAVEL AREAS FOR NEW CONSTRUCTION ABOVE FLOOD ELEVATION ELIMINATES NEED FOR ADDITIONAL SITE DISTURBANCE
- ONCE OPERATIONAL, EXISTING SYSTEM CAN BE DECOMMISSIONED TO PROVIDE AREA WATER STORAGE, RECIRCULATION, AND/OR REUSE
- RECREATIONAL PATH PROVIDES RIVER ACCESS AND CONNECTS TO CENTENNIAL PARK

FINAL DESIGN

- STORAGE INCREASES FLEXIBILITY FOR FUTURE USES: IRRIGATION OF CITY PARK OR VINEYARDS, FIRE STATION USE
- STRATEGICALLY LOCATED DECIDUOUS TREES PROVIDE SUMMER SHADE TO COOL EFFLUENT
- NATIVE VEGETATION PROVIDE WILDLIFE HABITAT: COVER AND FOOD SOURCES
- GRAVITY FLOW USED TO MINIMIZE ENERGY NEEDS
- INFILTRATION BASINS FACILITATE PERMITTING AS A REUSE FACILITY, PROVIDE STREAMBANK RECHARGE, AND FURTHER COOL WATER TEMPERATURE



SELECT REFERENCES & RESOURCES

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