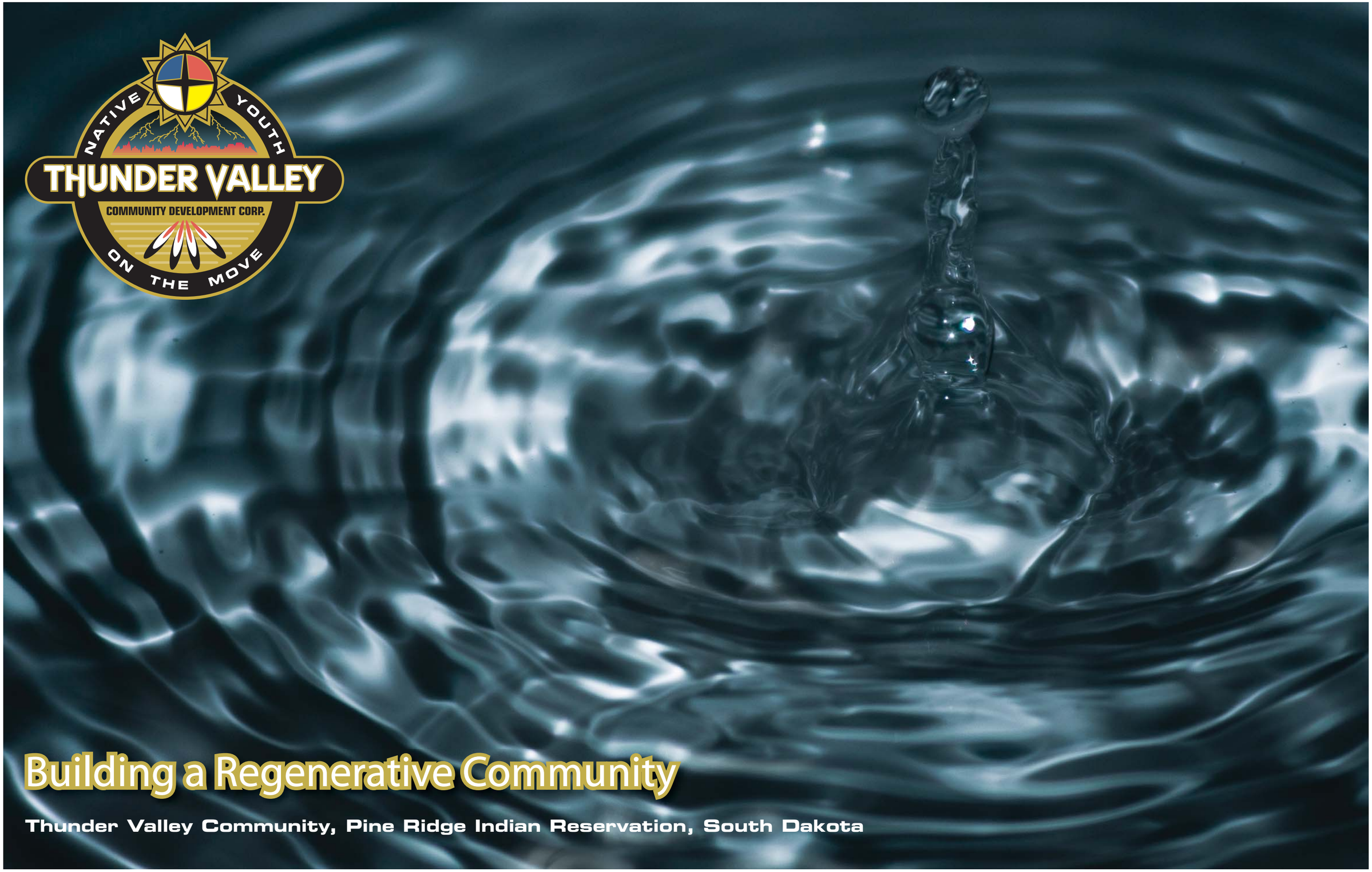

Building a Regenerative Community

Thunder Valley Community, Pine Ridge Indian Reservation, South Dakota

In partnership with

WOPILA | THANK YOU

This report synthesizes the outcomes of a workshop held in Porcupine, South Dakota on May 13 and 14, 2013. Thunder Valley CDC, organized this workshop to bring community members and partners together to consider the next steps for regenerative community development on a 34-acre parcel of land just north of Sharps Corner in the Porcupine District of Pine Ridge Indian Reservation.

Sincere thanks goes out to the following individuals who attended this workshop to give their knowledge and support to this transformational project (listed alphabetically):

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ABOUT THUNDER VALLEY

Thunder Valley is located in the northern part of the Pine Ridge Indian Reservation, Oglala Lakota Nation between Sharps Corner and Rockyford. The heart of this winding valley was formed over thousands of years as Porcupine Creek carved its way through the grass-covered hills at the edge of the badlands of South Dakota. It was long ago in this region that the Lakota people originated, having spread out and flourished in the 18th and 19th centuries. The origins of the name Thunder Valley have long been forgotten, and until recently only the elders and old ranchers still used the name. Now the name is synonymous with an amazing renaissance of traditional values and cultural pride.

In 1998 the rebirth of the ancient rite of traditional Lakota Sun Dance was reintroduced in the Thunder Valley community. This celebration of sacrifice, life and rebirth laid the foundation for change, offering culture, tradition, and a renewed sense of responsibility toward family and community. As this circle of change grows larger with each passing season, more and more individuals and families have become involved creating the energy and passion needed to set a powerful path forward.

The Thunder Valley Community Development Corporation was created in 2007 using this same energy of resiliency and community values. Nurtured from conversations voiced by youth to elders who realized we honor the best of our past by utilizing new tools, new ideas and new strategies as we create the opportunities of the future, Thunder Valley CDC came into being.

Thunder Valley Community Development Corporation (CDC) is a Oglala-led, Native American 501(c)3 non-profit public charitable organization based out of the Thunder Valley community of the Porcupine District on the Pine Ridge Indian Reservation. Our mission is empowering Lakota youth and families to improve the health, culture, and environment of our communities, through the healing and strengthening of cultural identity.

Our Mission:
Empowering Lakota youth and families to improve the health, culture and environment of our communities, through the healing and strengthening of cultural identity.

A CALL TO ACTION

Thunder Valley CDC was inspired by the Lakota way of life. It is part of a generation of young Lakota people who have begun to reconnect and reclaim our Lakota cultural and spiritual identity. Through building a foundation of cultural identity, a sense of responsibility for the current and future generations has been instilled in us. We honor our elders and ancestors that have come before us and fought for our way life, held on to our lands, and built the very foundation we stand on today.

Thunder Valley CDC looks out into our communities and we see our people in struggle. We see the harsh impacts of poverty, lack of housing, lack of jobs, poor education and many who have lost hope. Our work is dedicated to changing that struggle and making a difference. Our approach is from the bottom up not from top down. We strongly believe that the solutions for changing our communities on Pine Ridge are here, amongst the people, in our spirits, in our innovations, prayer, creativity and hard work.

PLANNING FOR A BETTER FUTURE

Beginning in 2010, Thunder Valley CDC coordinated a regional planning process for the Oglala Lakota Nation on Pine Ridge Indian Reservation through the inaugural grant of the Department of Housing and Urban Development (HUD) Sustainable Communities Regional Planning Program. This regional plan is called Oyate Omniciye | Oglala Lakota Plan, and has been adopted by two successive tribal councils at this time.

Oyate Omniciye began with conversations involving a small circle of Lakota elders who talked about what Lakota people do when getting together to "plan" for something important. During conversation, a dialogue emerged about whether the Lakota language had a word for "sustainability". Ultimately, the group came to the simple words: Oyate Omniciye – Roughly translated, "The Circle Meetings of the People". The phrase carries deeper meanings. First, "Oyate" refers not only to humans, but to all living beings. Secondly, calling for an "Omniciye" is not to be taken lightly. This word signifies that very important things are to be considered, and in the way of the Lakota, the ultimate goal is to seek consensus for all who wished to remain in the conversation. The goal was to create a Regional Plan, developed through communication and partnerships of those living and working within this 'Region,' which encompasses the boundaries and jurisdiction of the Oglala Lakota Nation.

Thunder Valley CDC facilitated community conversations. These conversations included input from children, elders, elected officials, community leaders, all those vested in building a healthy and sustainable tribal community. This collaboration of committed citizens, organizations, tribal and outside agencies took an in-depth look at existing systems that affect everyday lives of those living on the Pine Ridge Indian Reservation. An honest and collaborative conversation about the challenges our tribal communities face and what lies in the future, was made possible by information gathering and community outreach.

The overarching objectives in this regional sustainability plan for the Oglala Lakota are to:

- Continue the healing and strengthening of our people by bolstering identity and opportunity through the unique and beautiful perspective of Lakota knowledge, culture, and language.
- Reinvigorate a thriving, dynamic, and robust society where all share in the benefits.
- Honor our connections with the Earth and seek out ways to protect her environment.
- Create meaningful economic and job opportunities that reignite cultural identity.
- Promote and enhance public health, and awareness of healthy alternatives.
- Provide and enhance infrastructure, housing, and social services at an affordable cost.

From broad public engagement and professional analysis during this two-year planning process, twelve interrelated initiatives emerged that hold the greatest potential for achieving the objectives above. One of the first of these initiatives to move forward to implementation is an effort that supports and integrates many of the goals of the Oyate Omnicye plan: the development of a Model Community in Thunder Valley.

48%
OF RESIDENTS ON THE RESERVATION LIVE BELOW THE POVERTY LINE.

2500
LOW INCOME FAMILIES WITH UNMET HOUSING NEEDS. 70% OF ALL HOUSEHOLDS ELIGIBLE FOR HOUSING SERVICES.

70%
OF ALL HOUSING ON THE RESERVATION IS HUD HOUSING OR A TRAILER HOME. MOLD HAS BEEN FOUND IN 75% OF HOUSING UNITS.

60%
OF THOSE WHO LIVE ON THE RESERVATION WORK SOMEWHERE ELSE, AND 56% TRAVEL MORE THAN 50 MILES TO WORK.

1/4
THE SALES VOLUME AND THE NUMBER OF JOBS AND BUSINESSES PER CAPITA ON THE RESERVATION COMPARED TO THE SURROUNDING REGION.

48 52
IS THE LIFE EXPECTANCY OF MEN AND WOMEN RESPECTIVELY ON THE RESERVATION – ONE OF THE LOWEST IN THE WESTERN HEMISPHERE.

3
TIMES HIGHER GROWTH RATE ON THE RESERVATION THAN THE REST OF SOUTH DAKOTA.

A NEW APPROACH TO SYSTEMIC CHALLENGES

The goal of the Thunder Valley Regenerative Community is to create a sustainable and interconnected community that provides better housing, places for business to thrive and a healthy supportive environment for youth, elderly and families. The community is envisioned as a living laboratory to build skills, knowledge and capacity for residents. This project will explore and refine new ways of living that build on traditional Lakota values to develop innovative, homegrown Native solutions to a variety of challenges.

While many other rural areas in the Great Plains are facing stagnant growth, the population at the Pine Ridge Indian Reservation is growing significantly. Even though Census figures are widely understood to undercount population on the Reservation, they still show a growth rate of more than 21% between 2000 and 2010 - nearly three times the growth rate of South Dakota. More than half of Pine Ridge residents are under the age of 25. This population growth underpins an existing and growing demand for housing and services on the Reservation.

However, the construction of new housing has not kept pace with the increasing need. Land fractionation, complicated property ownership, lack of available land, and limited access to financing all present barriers to the construction of new housing. In addition to financial and regulatory obstacles, affordability is a factor that limits access to quality housing for many. The median household income on the Pine Ridge Indian Reservation is $27,065, compared to the state median income of $46,3691. About 48% of residents on the Reservation live below the poverty line. These low incomes severely limit the availability and quality of housing for Pine Ridge residents. Out of approximately 4,700 total households, 3,300 (70%) are eligible for Oglala Sioux Lakota Housing services, which estimates that there are unmet housing needs for more than 2,500 low-income families.

Lack of supply and low incomes contribute to overcrowding, low quality construction, and poor housing conditions. The average household size on the reservation is between 6.7 and 9.2 persons, compared to a national average of 2.6 persons per household. While this reflects to some degree differences in Native family structures, it is also an indication of overcrowding. Homes without adequate plumbing or kitchen facilities are often used as an indicator of inadequate housing conditions. On the Reservation, 9% of units lack adequate plumbing and 8% lack kitchen facilities; the national average for these condition are .5% and .8% respectively. Beyond physical housing conditions, many families face difficult home environments (suicide rates that are five times the national average highlight the severity of these challenges).

Compounding challenges from a lack of housing and poor housing conditions, the scattered patterns of housing developments make it difficult to provide basic infrastructure to many homes. Through transportation costs, water quality, air quality, and more, current housing development patters reduce the health, freedom, and prosperity of our people. Too often, existing housing clusters have become sources of crime and violence.

The Thunder Valley Regenerative Community begins to address community needs by providing more housing that is high quality and affordable, exploring creative approaches to overcome financial and regulatory barriers, and creating healthy, supportive living environments. However, the Thunder Valley Regenerative Community is also about more than housing. This project provides an opportunity to create a sustainable and interconnected community where there are education and workforce development opportunities, places for businesses to thrive, and places for youth to participate in healthy, safe activities. Thunder Valley Regenerative Community can also function as a "living laboratory" that explores and refines new ways of living and replicable models to address a variety of needs throughout the Reservation. While this project is not the entirety of the solution for housing needs on the Reservation, it can simultaneously provide housing and services, while building skills, knowledge, and capacity to tackle housing challenges on a wider scale.

A REGENERATIVE COMMUNITY

The site of the future planned community is located ¼ mile north of Sharps Corner, in the Porcupine District. The project is driven by the need for jobs, housing, facilities, and new opportunities that don't currently exist on the Reservation, and emphasizes the need to create new systems that foster and bolster social change through action and sustainable development. The proposed development is located on fee-simple, deeded land, which will help enable it to secure financing more easily than tribal land.

On May 13 and 14, 2013, Thunder Valley CDC hosted a workshop to bring all of the partners together to discuss the population, density and locations of land uses, building types and infrastructure based on the objectives of the community to provide affordable, efficient homes, produce all energy on site, clean all waste water on site, and create a new high performance Lakota-grown economy. Several presentations were given to inform the work of the group including the presentation of a framework to evaluate alternative energy production and water reuse on the site to establish an overall live/work population goal; a presentation on housing studies including applicable financing mechanisms and the draft business plan for property management by Thunder Valley CDC; and finally a presentation on roads, soil conditions and tire baling applications. The following sections of this document represent the collective vision of the community for the design, development, performance, and mission of a regenerative community at Thunder Valley.

COORDINATING INITIATIVES

Sustainable Housing Research Project:
Through a partnership with the Native American Sustainable Housing Initiative, University of Colorado Boulder, Oglala Lakota College, and the South Dakota School of Mines and Technology, Thunder valley will complete a straw bale demonstration house and begin construction of a Structured Insulated Panel Demonstration House.

Workforce Development Through Sustainable Green Home Construction:
Open to all ages and educational backgrounds, this program teaches life skills and leadership development tools to provide financial literacy, debt education, and basic life planning. This program also includes occupational construction skills in an on-the-job training program where participants will be actively building green sustainable homes within the development of Thunder Valley.

Youth Build - Department of Labor Program:
This program provides classroom instruction and occupational skills training to at-risk individuals aged 16-24. Participants learn valuable skills as they build affordable housing for low-income or homeless individuals and families in their communities. Non-construction skills training will also include leadership development and community service elements to ensure that youth maintain a connection to their communities through service and volunteerism

Self-Help USDA Housing Program:
The Mutual Self-Help Housing Program makes homes affordable by enabling future homeowners to work on homes themselves. With investment of "sweat equity," each homeowner pays less for his or her home than if it were built by a contractor, providing low income families an opportunity to own their home.

Sustainable Home Ownership Project:
Thunder Valley is playing a lead role in the creation of the Sustainable Home Ownership Project (SHOP). This program will help families prepare and ready for Home Ownership on the Pine Ridge Indian Reservation. This is partnership with Thunder Valley CDC, Mazaska Oweecseo Otipi Financial, OST Partnership for Housing, The Lakota Funds, The Lakota Federal Credit Union and Oglala Sioux Lakota Housing.

Worker-Owned Construction Company:
Thunder Valley is exploring the creation of a worker owned construction-company to build parts of the development and compete regionally in the construction industry. In 2014 Thunder Valley CDC will do a market study, feasibility study that will inform the decision to move forward with the creation of the company as a community asset and wealth creation model.

Community Food Systems Strategy:
In 2014, Thunder Valley CDC is pursuing resources to look at a community food systems strategy for the region to address food security and food sovereignty issues. This research will directly inform a strategy to create a better food system for the Pine Ridge Indian Reservation which could result in a grocery store, food distribution center, a food hub, commercial green house, or other projects within the development at Thunder Valley.

93
JOBS CREATED ON THE RESERVATION FROM NEW CONSTRUCTION.

5824
IN ANNUAL FUEL COST SAVINGS FOR EACH RESIDENT WHO DOES NOT NEED TO COMMUTE TO OR FROM RAPID CITY DAILY.

20
AT-RISK STUDENTS BUILDING 5 HOMES THROUGH THE DEPARTMENT OF LABOR'S YOUTH BUILD PROGRAM.

100%
OF IRRIGATION PROVIDED BY ON-SITE ECOLOGICAL WATER TREATMENT, RESTORING SURPLUS TO AQUIFER

0
INCREASE IN STORMWATER RUNOFF AT FULL BUILD-OUT.

60%
REDUCTION IN BASELINE ENERGY USE.

98%
OF ENERGY NEEDS PROVIDED BY RENEWABLE SOURCES.

THUNDER VALLEY MASTER PLAN

1	Empowerment Center (55,000 sf, 1.5 stories)
2	Central Plaza / Market (100' x 250')
3	Visitor Parking / Bus Drop-off
4	Business Incubator / Retail / Apartments (40,000 sf, 2-stories)
5	PowWow Grounds (100' diameter)
6	Youth Shelter
7	Skateboard Park / Ropes Course
8	Studio Space / Apartments (1 @ 30,000 sf, 1 @ 18,000 sf, 2-stories)
9	General Parking (50 stalls)
10	Light Industrial (30,000 sf, 1-story)
11	Loading Dock Area (160' x 190')
12	Flex Space / Office Space / Retail (30,000 sf, 1-story)
13	Townhouses (3 @ 10,000 sf, 8 units per building, 24 units total)
14	Outdoor Basketball Court
15	Single Family Housing (27)
16	Co-housing Cluster (equivalent to 4 single family houses)
17	Aquaponics Greenhouses (2 @ 6,000 sf ea.)
18	Outdoor Garden (15,000 sf)
19	Bunkhouses (1,600 sf, 3 buildings)
20	Spiritual Spaces / Traditional Medicinal Plants

The power of a master plan is to communicate the whole vision for a place. The master plan for Thunder Valley Regenerative Community provides the holistically conceived framework to achieve implementation of sustainable infrastructure, homes, and commercial buildings. The organization is informed by the topography of the land, water flow, and integration of culturally important spaces for a thriving Lakota community.

The capacity-building inputs and outputs explored at the two-day workshop in May 2013 resulted in the master plan shown here. The master plan illustrates the adjacent land uses and movement through the site by foot, bike, or vehicle. The hub of the community is the Empowerment Center. This mixed use building has flexible spaces for life long education programs and workforce training, meeting space, administrative offices for Thunder Valley CDC, a Cultural Arts Center, a daycare for children of families working in this development, and health and fitness facilities including flexible space for a clinic to operate on some days. This is where a visitor comes first to learn about Thunder Valley and the Lakota culture. The Cultural Arts Center will tell the story of the Lakota Nation and showcase the talent of local artists, past and present. Adjacent parking will be convenient to this central building, but will also be buffered by plantings to mediate the pollution from the road and collect stormwater runoff from the roads and parking area. This main entrance also leads directly to the youth shelter, temporary housing for the most vulnerable in Thunder Valley CDC's mission to address social, economic and cultural issues facing native youth.

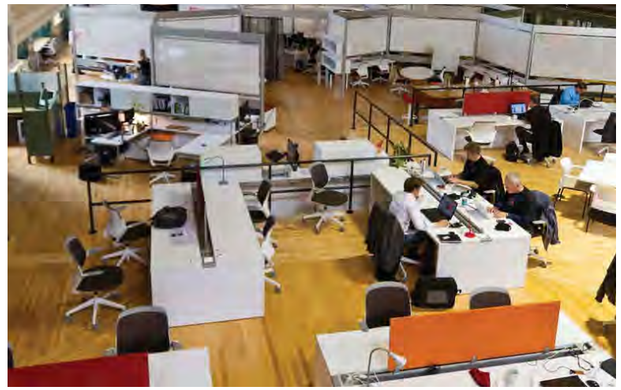
The Empowerment Center is part of a cluster of buildings centered on Pow Wow grounds. Just north of the Empowerment Center is an open air market space, and a mixed use two-story building programmed for business incubation, private offices, and retail shops on the ground floor with apartments above. To the west of the Pow Wow circle are two two-story buildings that will function as artist studio spaces and apartments. The areas south and west of these buildings include a skatepark, a ropes course, walking paths and gardens with edible plants and traditional medicinal plants to create spaces for relaxation, exercise, meditation, worship, community gathering, and outdoor classroooms or studios.

The north part of the site is dedicated to commercial uses, both light industrial, and flexible office and retail space. Wider roads of higher compaction strength are designed for this area to allow for large delivery trucks. During the construction phases, materials and staging would be coordinated here.

The south part of the site is primarily residential and demonstrates several types of housing including a high efficiency single family type, attached townhomes, a co-housing cluster of single family homes in close proximity for extended family, and a bunkhouse for visiting volunteers and students. This area provides permanent housing for 55 households. The apartments and studio spaces on the north part of the site provide space for approximately 60 more households to live and work on site.

Lastly, the aquaponics greenhouses and large community garden are located on the south, and lowest, part of the site. These facilities serve the health and well-being of all who come to live, work, and learn in this environment.

The following illustrations show two views of the development to further describe the spaces and activities occurring there. The next sections of this document describe some of the layers of performance and preliminary engineering analysis of this development.



Images of example programs (top to bottom):
Skatepark; High performance construction and training programs; Pow Wow grounds

Images of example programs (top to bottom):
Aquaponics high tunnel; Artist studio space; Business incubator

OUTDOOR MARKET
This large outdoor space is located between the Empowerment Center and Business Incubator. The space provides residence with a large outdoor flexible space but also allows for a space for tourists to shop for goods produced by local artisans

EMPOWERMENT CENTER
This facility houses cultural and community services.

GYMNASIUM
Indoor basketball court, doubles as a storm shelter. This facility is connected to the Empowerment Center / Fitness Center.

BASKETBALL COURT

YOUTH SHELTER
Adjacent to many of the activities available at Thunder Valley, the facility provides youth guest rooms and counseling services

ROPES COURSE

SKATE PARK

SOLAR PANEL GATEWAY
This canopy produces energy in addition to creating a shaded outdoor space

This conceptual illustration shows the heart of Thunder Valley. The Empowerment Center and surrounding market, powwow grounds, and studio space create a cultural and community center.

TRADITIONAL POW WOW GROUNDS ARBOR

POWWOW GROUNDS
Located along the central green space

ARTIST STUDIOS AND LOFTS
Lower floor opens out onto the central green and provides flexible space for artists and other activities. Second level has apartments.

SINGLE FAMILY RESIDENCE
Arranged on quarter acre lots, this development composition allows for shared outdoor space, gardening, and the development of a trail system

SPIRITUAL SPACE
Tucked behind the ridge line from the main development area, this space will provide a more secluded space for traditional ceremonies and medicinal plant cultivation

CO-HOUSING MODEL
This housing model consists of a cluster of single family residences spaced closer together in a half moon. The form is traditional to the Lakota people and offers a protected shared space and stronger sense of community

ROPES COURSE

BASKETBALL COURT

WIND TURBINE

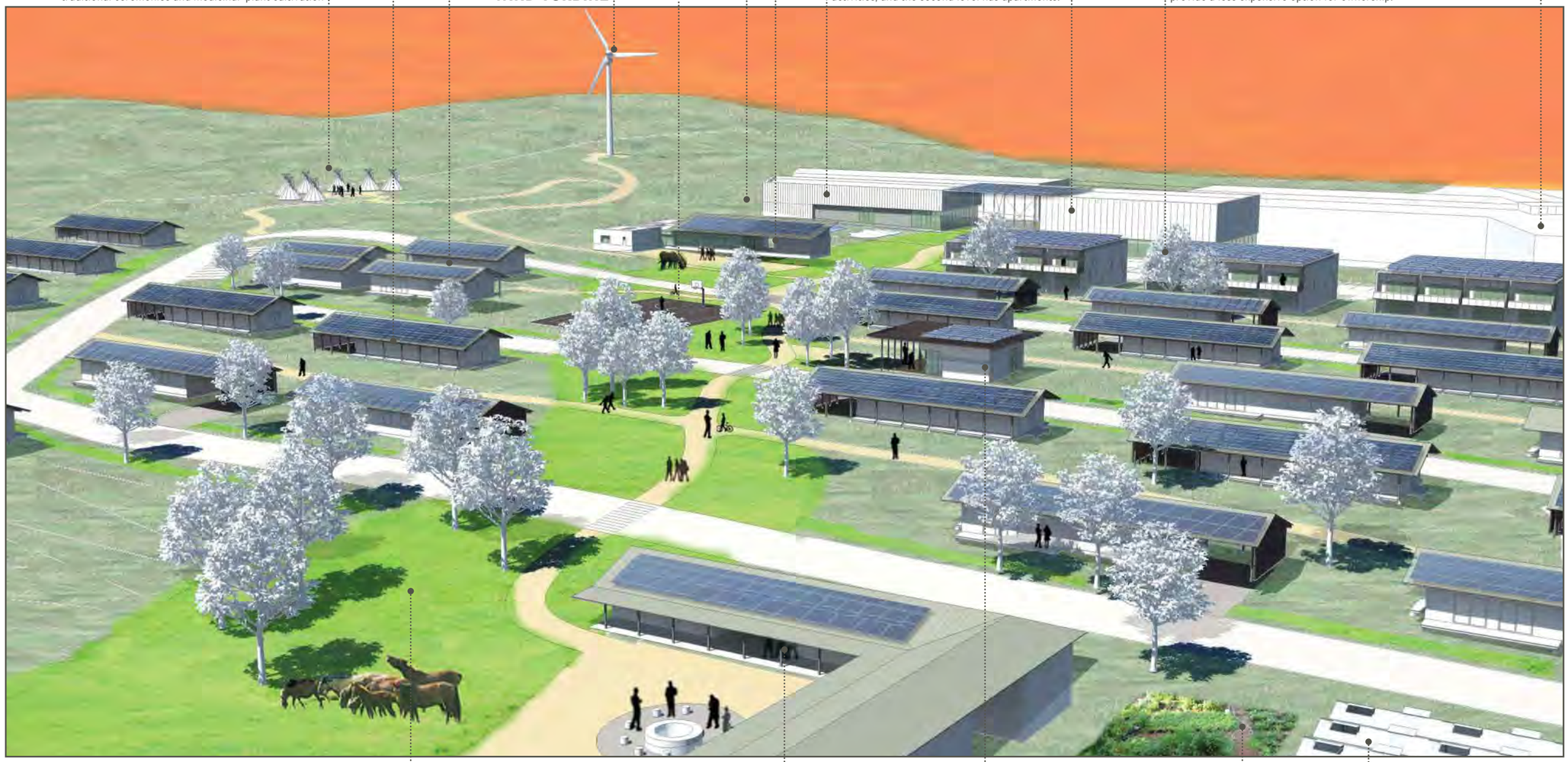
YOUTH SHELTER
Adjacent to many of the activities available at Thunder Valley, this facility provides youth guest rooms and counseling services

ARTIST STUDIOS AND LOFTS
The lower floor opens out onto the central green and provides flexible space for artists and other activities, and the second level has apartments.

GYMNASIUM
This Indoor basketball court, doubles as a storm shelter, and this facility is connected to the Empowerment Center / Fitness Center.

TOWNHOUSES
These units are of similar size to single family houses and each have their own front door. These units will provide a less expensive option for ownership.

DAY CARE FACILITY
Connected to the Empowerment Center and adjacent to the outdoor playground, this facility is located to provide easy drop off and pick up



This conceptual illustration shows a view of the residential area. The view is centered on the main green shared space and highlights the many community uses in that space and surrounding buildings. The surrounding structures showcase the range of residential options available on site.

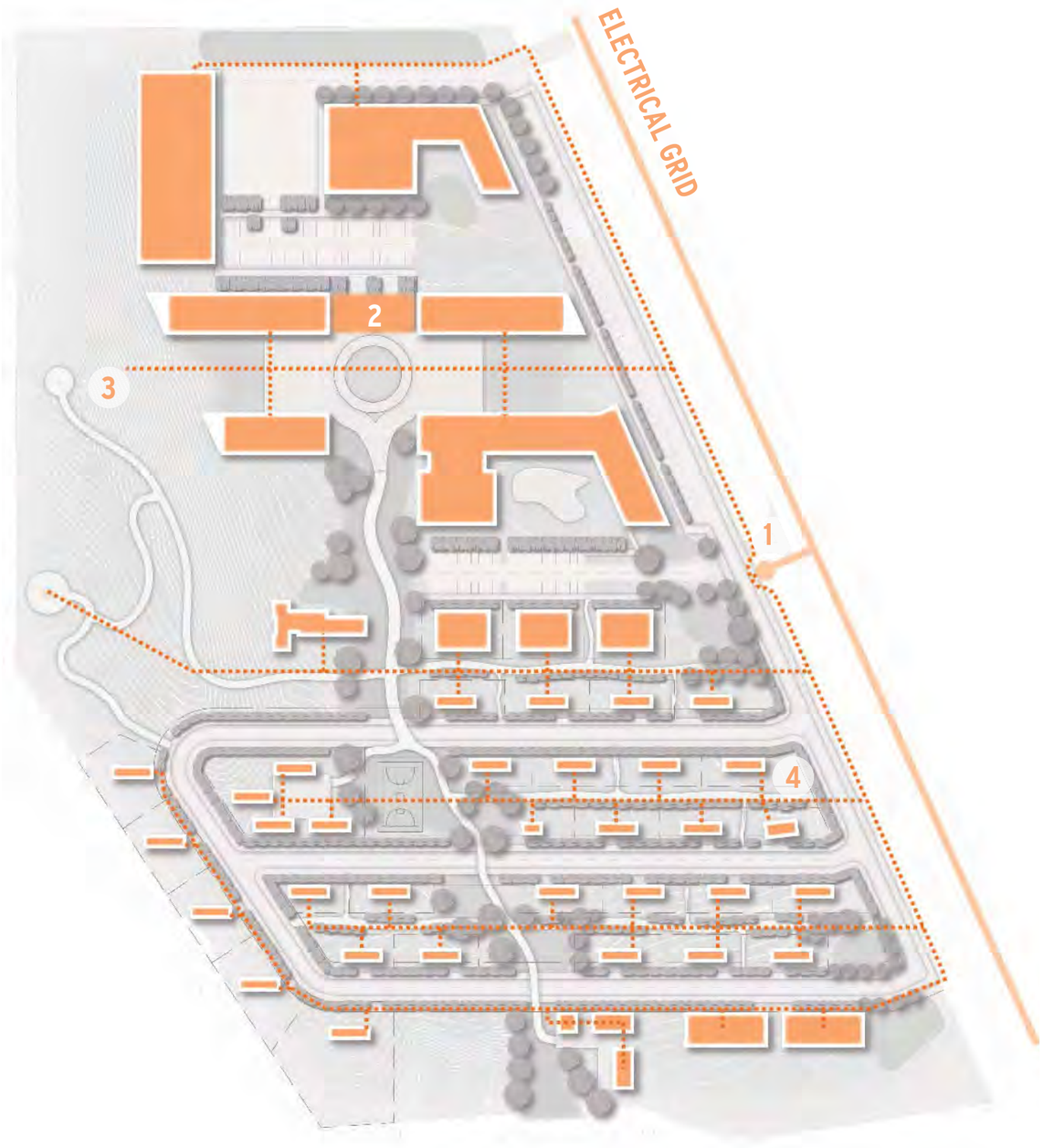
CENTRAL GREEN CAMPING SITE

BUNK HOUSE
Available to visitors and volunteers of Thunder Valley. This building houses two sleeping quarters and a shower house

COMMUNITY KITCHEN
Centrally located in the residential area, this facility provides a large gathering place for community members to eat together and host celebrations

GARDEN

AQUAPONICS GREENHOUSE
Aquaponics is a method of food production which combines raising fish with growing vegetables. This method produces the greatest amount of food in the smallest footprint and each waste product fuels a needed input, creating a harmonious system



RENEWABLE ENERGY SYSTEM

Total Development Energy Use = 8,524,000 kBTU
(assumes 60% reduction from typical baseline)

Total Development Renewable Energy Supply = 8,410,580 kBTU
(from solar arrays and one 100 kW wind turbine)

EXISTING ELECTRIC GRID (OVERHEAD)

LOCAL UTILITY GRID (BURIED)

ROOF MOUNTED SOLAR ARRAY

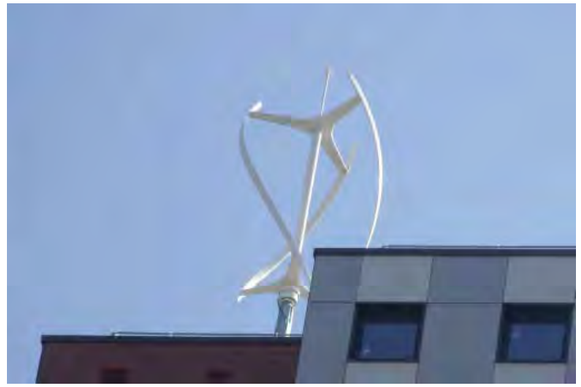
1 SWITCHING STATION AND DEVELOPMENT METER
2 SOLAR PANEL "GATEWAY"
3 WIND TURBINE
4 INDIVIDUALLY SUB-METERED HOUSING, TYPICAL

In considering the balance of energy needs, it is a priority of Thunder Valley CDC to be able to produce all energy needed on the site. This plan shows how 98% of this need is met through roof-mounted solar panels on each building and one wind turbine in its optimal location at the top of the hill. More solar panels could be added over the parking areas and some of the larger buildings may benefit from roof mounted turbines.

Through attention to passive (solar siting for panel angle and natural lighting, and thermal material use) and active (insulative construction systems, ground source heat pumps, gravity fed decentralized water treatment) strategies the performance of each building may be "tuned" over time for maximum energy efficiency. It is recommended that Thunder Valley CDC set performance benchmarks during the design phase and build in ways to monitor and improve performance over time.

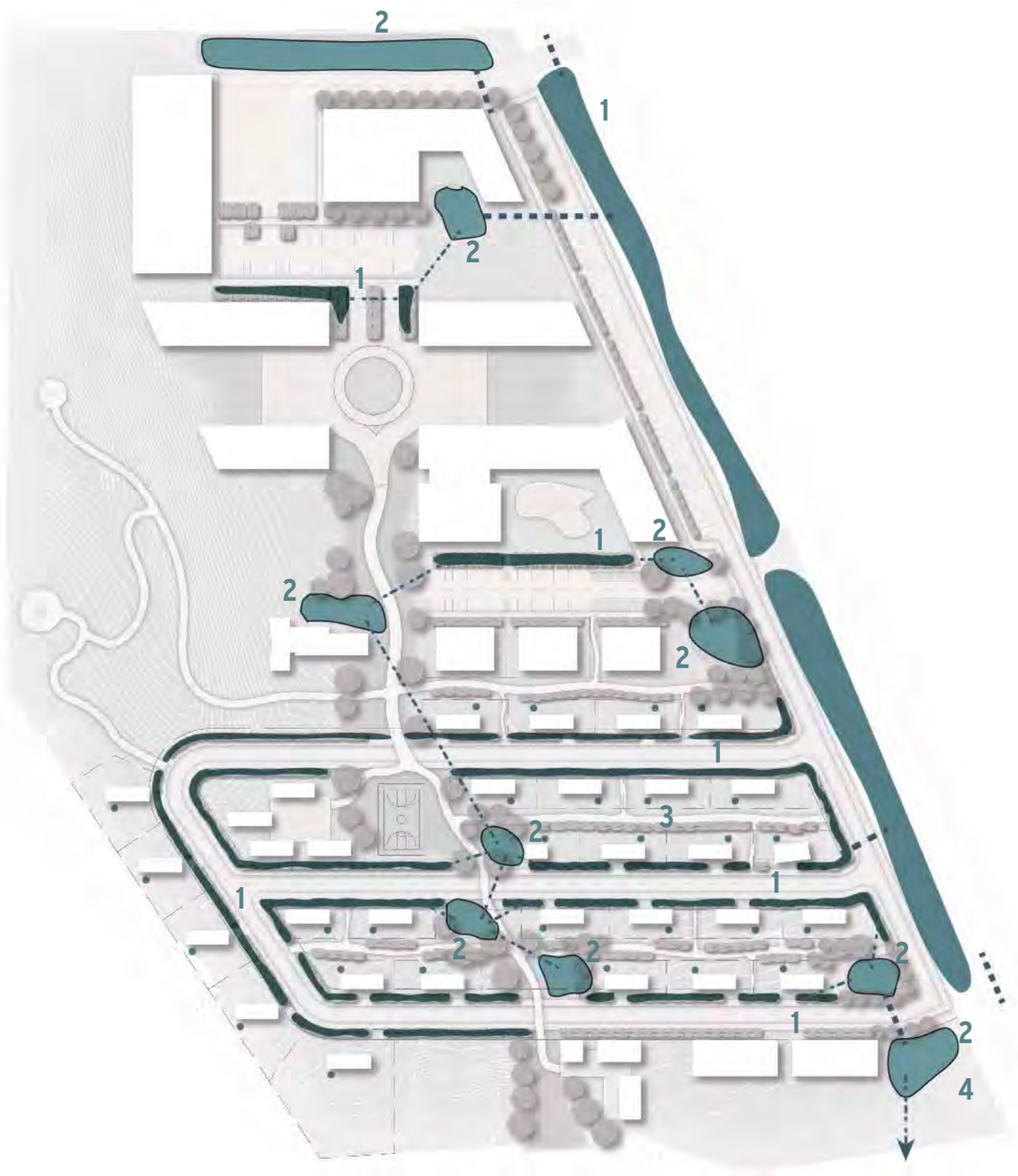
Behavior of the people on the site is also key to an energy efficient environment. Using natural light as much as possible, using the most efficient equipment and appliances, and conservative water use all help to decrease the burden on overall energy needs.

The development would be tied to the rural utility grid in case of inclement weather or battery backup failure. It is possible that the development would be supplying power to the grid during some times of the year and that the rural utility would be able to sell Greenhouse Gas (GHG) credits through the development, thereby offsetting costs for residents and businesses located on the development.



Images of example programs (top to bottom):
125 mW wind turbine; roof mounted wind turbine

Images of example programs (top to bottom):
Roof mounted solar panels in a multi-family residential development; Parking and walkway shade structure with solar panels.



STORMWATER SYSTEM

RAIN WATER COLLECTION CAPACITY
(FROM ROOF AREA) = 5,060 GAL/DAY

- RAIN BARREL
- REINFORCED CONCRETE PIPE CULVERTS
- UNDERGROUND PIPE CONNECTIONS
- SURFACE DRAINAGE SWALE

1 SURFACE BIOSWALE AT PARKING / ROADS
2 SURFACE RAIN GARDEN / WATER COLLECTION
3 RESIDENTIAL COLLECTION - RAIN BARRELS AT EACH HOME
4 OVERFLOW INTO CREEK BED

Every drop of water is a precious resource, and intrinsically related to the health of people in a community. The Thunder Valley Regenerative Community will increase clean water sources by embedding strategies in streets, homes, and businesses to collect and use rainwater productively. Attention to daily habits as well as sensitive construction practices will help to clean the water that enters lakes and streams. This clean water will renew habitat as well as replenish the aquifers deep below the ground.

Scientific studies cited by the U.S. Permaculture Guild predict that the High Plains/Oglala Aquifer, which begins underneath the Pine Ridge Reservation, will likely run dry within the next thirty years due to commercial use and dryland farming in states south of the Reservation. This critical North American underground water resource is not renewable at the present consumption rate and recent years of drought have accelerated the problem. Thunder Valley CDC's regenerative development seeks to be a testing ground for water conservation and reuse strategies both for tribal nations and many other areas of the United States faced with this challenge.

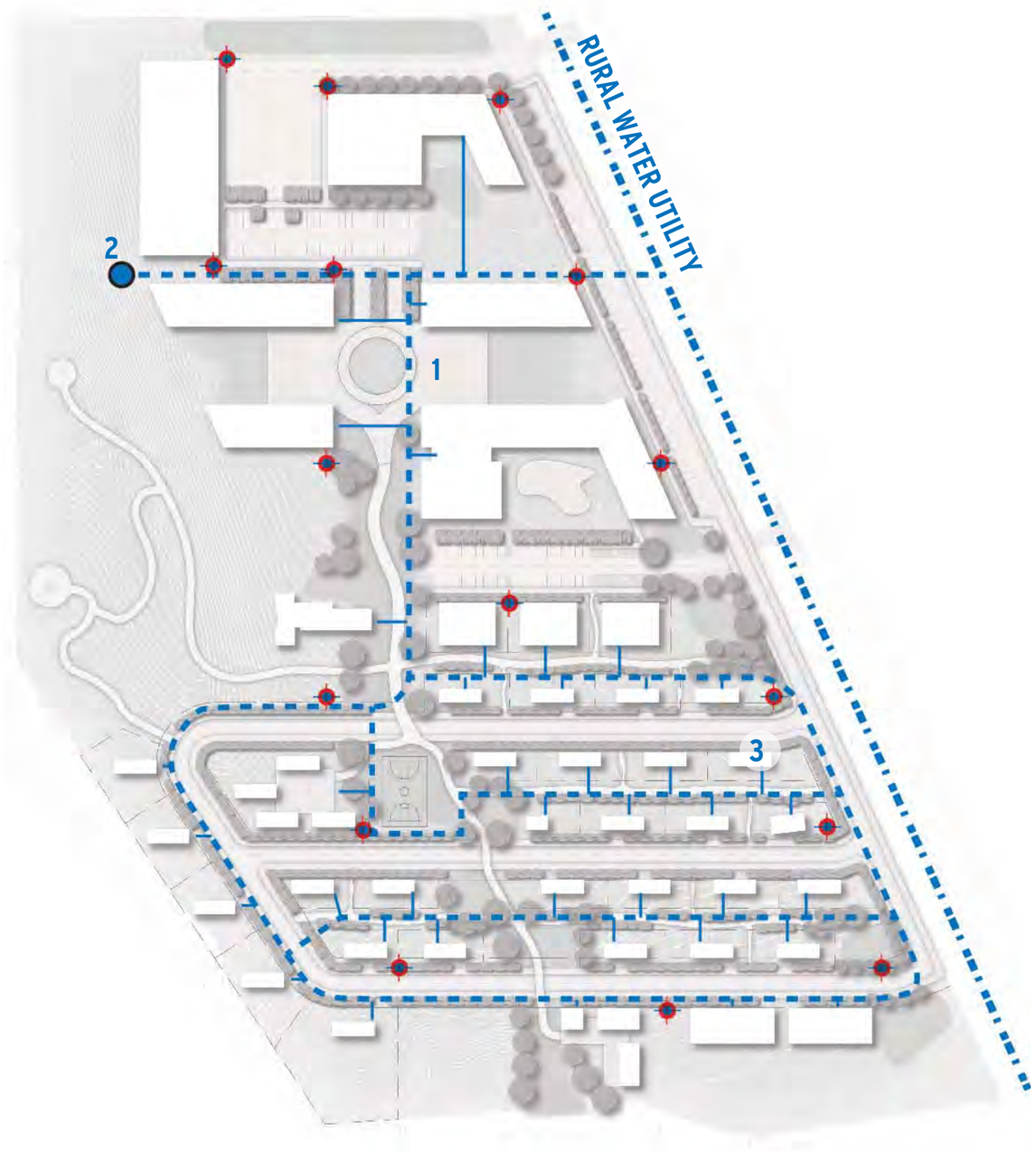
The alternatives studied in the preliminary engineering analysis included two primary systems:
1) Roadside bioswales, culverts, and rain gardens
2) Storm drain inlets, culverts, curb & gutter, and raingardens

The first alternative was recommended and is shown in the diagram to the left. It is not only the most cost effective but also provides the most capacity to filter rainwater and recharge the aquifer through vegetated areas.

The vegetated areas called bioswales indicated on the left are for conveyance of water, while the rain gardens, and rain barrels are for water capture. Future infrastructure improvements could include underground cisterns for rainwater capture as well. Depending on the filtration systems used and connections to buildings, underground cisterns may provide potable water, additional water for irrigation systems, or water to flush toilets in homes and businesses, thereby reducing the balance of potable water supply needed.

Images of example programs (top to bottom):
Bioswale buffer zones to capture and clean stormwater runoff in parking area; Middle and bottom images are of wetlands on campuses to capture and clean stormwater.

Images of cisterns (top to bottom):
Open air cistern; Stone cistern from early 1800s to catch rainwater for irrigation and farm animals; Modern day metal cistern to catch rainwater.



POTABLE WATER SYSTEM

TOTAL ESTIMATED DEVELOPMENT
WATER USE = 58,000 gallons/day

TOTAL STORAGE AT SITE = 238,000 gallons/day

- MAIN LINE
- LOCAL BRANCH
- FIRE HYDRANT
- ELEVATED WATER STORAGE TANK

1 DEVELOPMENT WATER LOOP
2 WATER STORAGE TANK
3 INDIVIDUALLY SUB-METERED HOUSING, TYPICAL

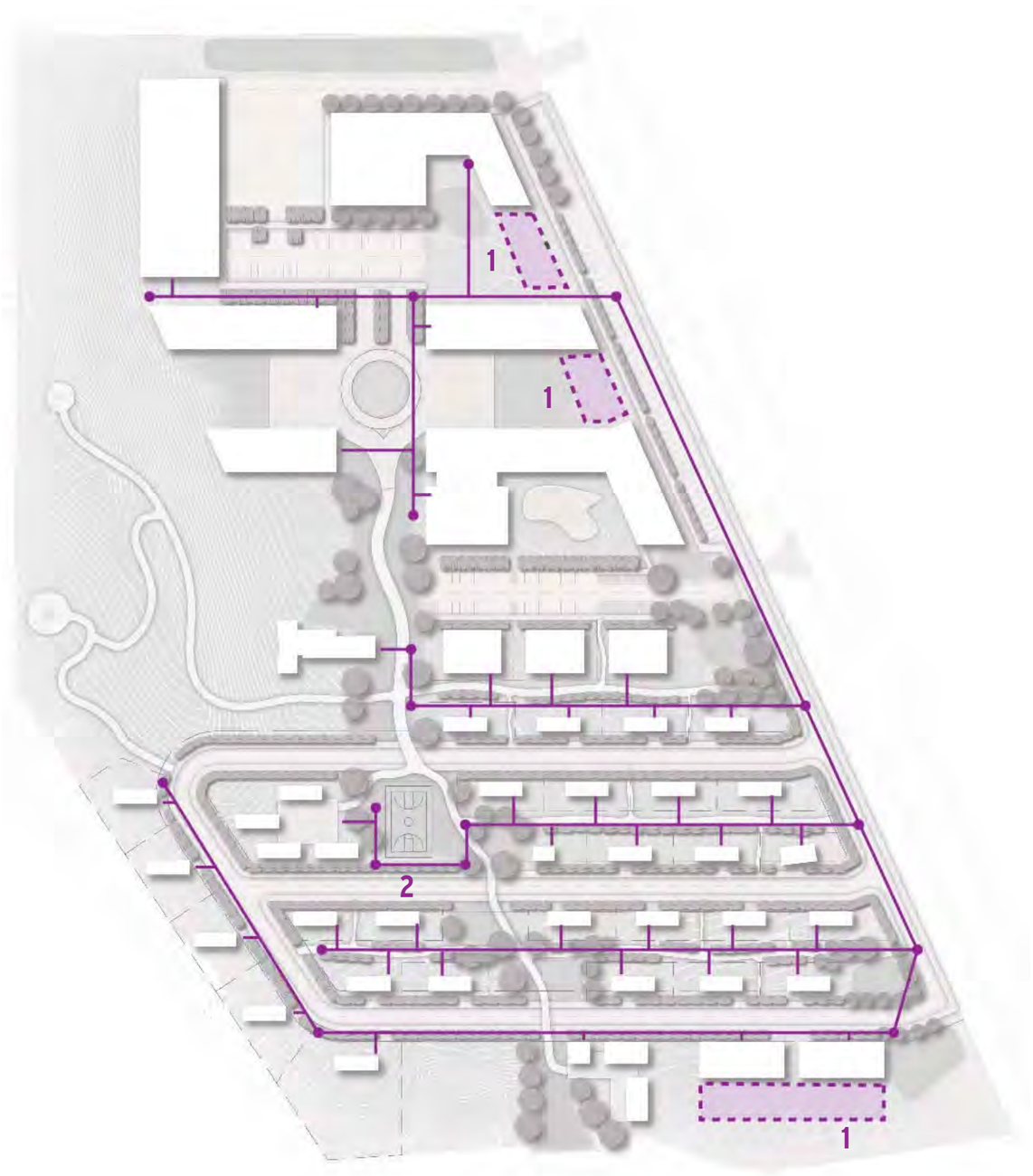
Water on the reservation has been tainted by Uranium mining and tests have shown the presence of Arsenic and Barium among other radioactive elements. Mni Wiconi, which means "water is life" in the Lakota language, is a large scale water infrastructure project that carries water to the reservation through pipelines from the Missouri River. The Mni Wiconi Water Treatment Plant and Coreline project will replace contaminated water sources and bring safe drinking water to communities throughout the reservation. The project was completed in 2013. The overall project has been managed by the OST Rural Water Supply System in partnership with the Bureau of Reclamations.

The ongoing funding sources for operations and maintenance as well as future expansion of the pipeline are in great doubt; citizens of the Pine Ridge Indian Reservation are not charged for water since it is supplied as a treaty obligation by the US government, however the Operations and Maintenance funds are at the mercy of Congress. This uncertainty makes water conservation and even greater priority.

The Mni Wiconi project has run a main water supply line (8" diameter) along the road (shown on the diagram), and the Thunder Valley CDC development may connect to this for water supply that is owned and regulated by the tribal Rural Water Department, or drill their own wells for private management of water supply. The development will maintain its own fire protection storage tank to maintain a daily supply of 238,000 gallons. The projected flow for an average day after total build out is 58,000 gallons, (the flow of a peak day is estimated to be 144,144 gallons) and flow needed for two hours of fire control would be 180,000 gallons. The tank may either be on the ground with a booster pump or an elevated tank. The recommended solution shown in the diagram to the left is the elevated storage tank connected to the existing water supply. This is the most cost effective solution that also provides a known adequate quality of water, excellent pressure, and requires the least energy to operate.

Current South Dakota standards are used for expected water demand. Through conservative water use practices and rainwater reuse this development will benchmark its water use and monitor meter readings to achieve an increasingly efficient balance of supply and use. Future infrastructure efficiencies could include graywater reuse and water routed from cisterns for potable uses, depending on appropriate filtration and permitting from South Dakota Department of Environment and Natural Resources.

Image of Mni Wiconi project laying water pipeline on Pine Ridge Indian Reservation from Missouri River



WATER TREATMENT AND REUSE SYSTEM

WASTEWATER FLOW TOTAL
58,000 gallons/day

TREATED EFFLUENT AVAILABLE FOR IRRIGATION MEETS AND EXCEEDS MONTHLY DEMAND FOR ENTIRE DEVELOPMENT

PIPES WITH MANHOLES

UNDERGROUND EXTENT OF CONSTRUCTED WETLAND BIOREACTORS

1 CONSTRUCTED WETLAND BIOREACTORS

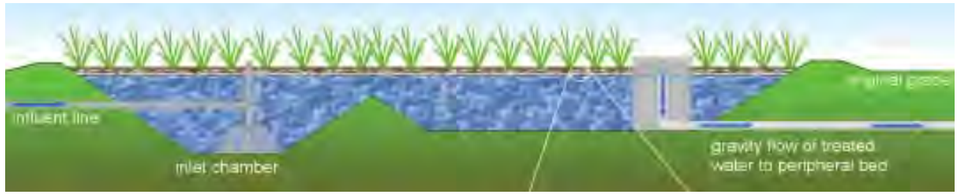
2 SANITARY PIPE SYSTEM FOR GENERATED WASTEWATER

The lagoon and water treatment systems throughout the Reservation have exceeded capacity and are not functioning well. Untreated waste water is overflowing into streams and groundwater. A new model of caring for our water is needed and this development seeks to provide that replicable model for the Reservation and other tribal nations.

The workshop discussion on wastewater treatment focused on treatment options that use natural processes to clean and reuse water on site. The preliminary engineering study analyzed five alternatives for sanitary sewer system collection and treatment:
1) Constructed Wetland Bioreactor System
2) Living Machine Treatment Facility
3) Orenco Treatment Unit
4) Discharge into Sharps Corner lagoons
5) Cluster Treatment Systems

Each of the alternatives was evaluated by cost, environmental impact, capacity to reuse treated waste water, land use requirements, and energy use. After analysis, two of the alternatives were determined inappropriate for this site - The Living Machine Treatment Facility, because it would need to be entirely enclosed due to extremely cold winter temperatures thereby resulting in high capital, energy, and maintenance costs; and Discharge into Sharps Corner Lagoons due to the high cost of purchasing 15 additional acres for additional lagoons and easements, operation costs, maintenance costs, energy costs for the lift station, and the inability to reuse effluent for irrigation. The Lagoon study was accomplished for due diligence and serves to prove that the status quo system on the Reservation is not an efficient model to continue to use.

The three systems that have the greatest potential to meet the goals of Thunder Valley Regenerative Community Development are the Constructed Wetland Bioreactor System, the Orenco Treatment Unit, and the Cluster Treatment Systems. Following are descriptions of each system and the final recommendation which is also diagrammed to the left.



Images of example systems (top to bottom):
Top row - Constructed wetland bioreactor diagram; Second row down - Constructed wetland bioreactor photo on left and installed Orenco Treatment System on right; Third row down - Living Machine indoor ecological waste treatment based on the plants and organisms of a tidal wetland on left and diagram of Orenco System on right; Bottom image - land intensive cluster treatment system

The Constructed Wetland Bioreactor (CWB) System utilizes naturally occurring biological processes to treat wastewater. The CWB consists of three feet of coarse gravel with a top layer of fine gravel. A shallow berm is maintained around the wetland area to aid in eliminating surface runoff, and an impervious liner to the wetland area is installed to eliminate groundwater contamination. The wastewater is piped in approximately 3 inches below the top of the gravel to make sure that the top layer stays dry, odorless, and does not promote insect breeding ground or human contact with wastewater.

Prior to wastewater entering the wetland, the wastewater goes through a tank to reduce solids and trap grease. Regular tank cleanout is a part of the operation and maintenance of this system. Liquid (effluent)from this primary treatment phase then enters the wetland where microorganisms that live in the coarse gravel and in the roots of plants that thrive in wetland conditions clean the effluent. The more microorganisms that grow in this wetland the faster it treats the water. The plant roots further increase the efficiency of the treatment through carrying oxygen and emitting molecules which stimulate the microbial system.

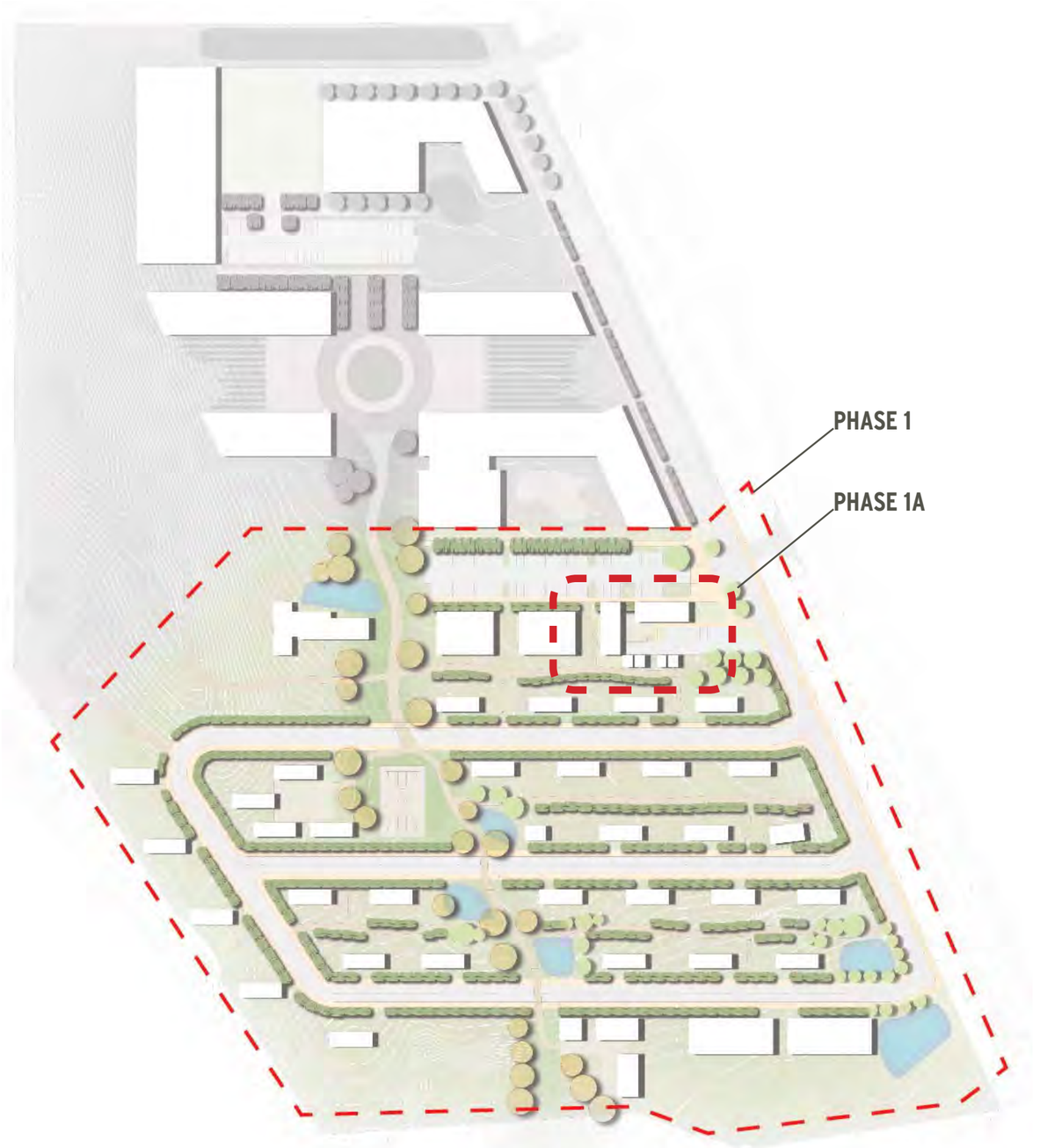
Once the effluent is treated it will be routed to storage tanks to be used for irrigation. The estimated irrigation need for the development is 860,000 gallons per month. Based on the anticipated average of 58,000 gallons of effluent daily, there will be more than enough to meet the development's irrigation needs and excess is discharged to Thunder Valley Creek to supply the watershed with clean water and recharge the aquifer.

The preliminary engineering study proposes that there would be three CWBs on the site. The placement of the CWBs would likely allow the flow to rely on gravity, thereby negating the cost and maintenance of pumps for operation. This decentralized approach reduces the amount of piping required to collect wastewater and redistribute treated water. This approach also allows the CWBs to be integrated throughout the development on approximately 1.6 acres of land currently owned by Thunder Valley CDC. Additionally, the plants grown in the CWBs provide habitat for many species of animals, generate oxygen, sequester carbon, and provide even more natural beauty to the development.

The Orenco Treatment Unit would be located in southeast portion of the site. All wastewater would be conveyed to this unit by 8" gravity sewers and 4" PVC pipes. The unit utilizes a recirculating filter to clean the effluent, not biological matter. All treated effluent could be reused for irrigation, similar to the CWB. There is no additional land requirement for this option. The Orenco Unit has a high capital cost and the operation and maintenance costs are two and a half times higher than the CWB option.

Individual or Cluster Treatment Systems were initially compared in the preliminary engineering study to evaluate whether each individual home could have its own wastewater treatment system handled on individual lots. It was determined that an individual treatment system requires a minimum of a half an acre with a rated capacity to handle 7,500 gallons per day. Since lots are 1/8 acre, this option was quickly discounted. A Cluster Treatment System would serve 15 homes with a central septic tank and drain field. It is assumed that the collection of wastewater and distribution of effluent would rely on gravity, thereby negating the cost and maintenance of pumps for operation. The simplicity of operation and maintenance as well as the low capital cost makes this the most cost effective option. However, the land required for one cluster system (15 homes) is 3.6 acres. If this type of system were used for all occupancies in the development, ten cluster systems would be needed, and 36 additional acres would be required solely for the systems and their drain fields. Another disadvantage is that with this system, treated effluent is not available for irrigation.

Based on the criteria to be affordable, energy efficient, land efficient, reuse treated effluent, and have a positive environmental impact the Constructed Wetland Bioreactor is the recommended approach to wastewater treatment and reuse.



NEXT STEPS

In the year since the workshop, analysis, programs, and partnerships have made rapid progress. This document includes the findings of the Preliminary Engineering Study. An Environmental Assessment was also accomplished including analysis of wetlands, soils, biological resources, historic properties, and environmental justice issues among other topics. Partnerships continue to grow as does the knowledge and capacity of Thunder Valley CDC to manage the development in a regenerative way. A National Advisory Board has formed over the past year including experts on the forefront of sustainable development, and tribal policy-making (a list of Board Members may be seen on the inside cover).

In 2014, Thunder Valley CDC plans to secure the financing for infrastructure for Phase 1 of the development (shown in the diagram to the left) and begin construction of infrastructure systems that have been described in this document including:

- Wastewater Treatment and Reuse System
- Potable Water System
- Roadways & walking paths
- Electrical System

Thunder Valley CDC will continue the Partnership with the Native American Sustainable Housing Initiative, University of Colorado Boulder, Oglala Lakota College, and the South Dakota School of Mines and Technology to complete the Straw Bale Demonstration House and begin construction of the Structured Insulated Panel Demonstration House. These prototypes are part of the Sustainable Housing Research Project which will include two other typologies to be built in 2015.

The first move of the development (shown as Phase 1A in the plan to the left and further detailed on the next page) will be Thunder Valley CDC's office space. The office will be moved to the north in order to allow the infrastructure and housing construction of Phase 1 to proceed over the next five years unhindered. At the time of the move, Thunder Valley CDC will expand the headquarters to include an additional 2,000 square feet of training and community gathering space for Youth Build and Workforce Development Training Programs. These programs will begin in 2014 and will be coordinated with implementation of Phase 1 home construction.

The Youth Build Department of Labor program is a nonresidential, community-based alternative education program that provides classroom instruction and occupational skills training to at-risk individuals ages 16-24. Participants have been in the juvenile justice system, are aging out of foster care, are high school dropouts, and are otherwise at-risk of failing to reach key educational milestones and opportunities that

lead to career fulfillment. Participants learn valuable skills as they build affordable housing for low-income or homeless individuals and families in their communities. Non-construction skills training will also include leadership development and community service elements to ensure that youth maintain a connection to their communities through service and volunteerism. Thunder Valley CDC plans to serve 20 individuals annually for the next five years. Each year participants will build one home in the Phase 1 area of Thunder Valley Regenerative Community.

Workforce Development Through Sustainable Green Home Construction is a new educational program inspired by the Youth Build model that is open to all ages and all educational backgrounds. Each participant will take part in an occupational training program that will include classroom time to reach their individual educational goals, and education on leadership development tools to improve their basic life skills in financial literacy, debt education, and basic life planning. Concurrently, these individuals will be taught occupational construction skills in an on-the-job training program. Thunder Valley CDC plans to serve 10 individuals annually for the next five years with this program. Each year participants will build one home in the Phase 1 area of Thunder Valley Regenerative Community.

Thunder Valley CDC will also manage a Self-Help USDA Housing Program (Section 523) that makes homes affordable by enabling future homeowners to work on homes themselves. With this investment in the home, or "sweat equity", each homeowner pays less for his or her home than if it were built by a contractor. This enabled very-low and low-income families an opportunity to own their home. Thunder Valley CDC plans to serve 12 families total over the next five years, in two cohorts of six.

In 2014 Thunder Valley is also playing a lead role in the creation of the Sustainable Home Ownership Project (SHOP). This is the creation of a new educational program that prepares families for home ownership on the Pine Ridge Indian Reservation. This is a partnership between Thunder Valley CDC, Mazaska Oweecseo Otipi Financial, OST Partnership for Housing, The Lakota Funds, The Lakota Federal Credit Union and Oglala Sioux Lakota Housing.

Other related explorations that are underway include a market feasibility study that will inform the decision to move forward with the creation of a worker-owned construction company to build parts of the Regenerative Community and compete regionally in the construction industry. If deemed feasible this company could be a new regional asset and wealth creation model.

Thunder Valley CDC is seeking resources to study a regional food systems strategy to increase food security and food sovereignty. Studying the dollars that flow the reservation for food and where that food comes

PHASE 1A

1 RELOCATED OFFICE
2 TRAINING CENTER
3 STORAGE SHEDS
4 PARKING
5 FUTURE PARKING
6 FUTURE TOWNHOUSE SITE
7 FUTURE SINGLE FAMILY HOME SITE

from will directly inform a strategy to create a better food system for the Pine Ridge Indian Reservation. This could result in a Grocery Store, Food Distribution Center, Food Hub, and/or commercial green house to be developed within the Thunder Valley Regenerative Community.

In the fall of 2014, Thunder Valley CDC plans to host a design workshop focused on the Empowerment Center. Partners and potential tenants will be invited to participate in this design workshop. Depending on changes to South Dakota charter school legislation, it is possible that one potential tenant may be a new K-12 charter school focused on teaching the principles of sustainability and Lakota culture.

Measuring the increase in vitality will be an important part of the transformation of this community over time. Thunder Valley CDC has identified an international program called One Planet Communities that assists communities around the world in creating trackable and achievable performance goals.

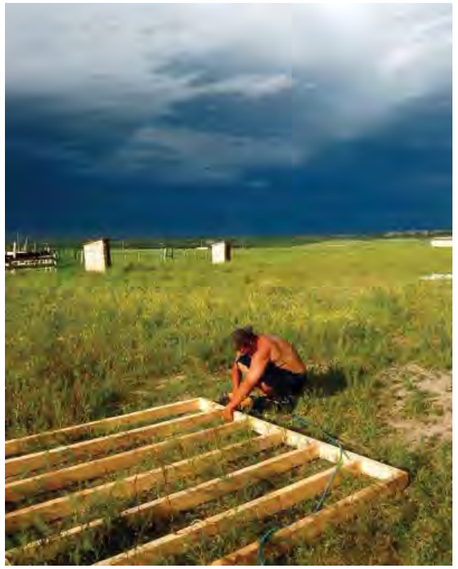
> *The One Planet Communities program is creating a network of the earth's greenest neighborhoods. By working with private and public property developers it aims to help create places where it is easy, attractive and affordable for people to live healthy, happy lives within a fair share of the earth's resources.*

The first step in their program of creating performance goals and accountability, is for the community to design an action plan around the ten One Planet principles:

1. Zero carbon: Making buildings more energy efficient and delivering all energy with renewable technologies.
2. Zero waste: Reducing waste, reusing where possible, and ultimately sending zero waste to landfill.
3. Sustainable transport: Encouraging low carbon modes of transport to reduce emissions, reducing the need to travel.
4. Sustainable materials: Using sustainable healthy products, with low embodied energy, sourced locally, made from renewable or waste resources.
5. Local and sustainable food: Choosing low impact, local, seasonal and organic diets and reducing food waste.
6. Sustainable water: Using water more efficiently in buildings and in the products we buy; tackling local flooding and water course pollution.
7. Land and wildlife: Protecting and restoring biodiversity and natural habitats through appropriate land use and integration into the built environment.
8. Culture and heritage: Reviving local identity and wisdom; supporting and participating in the arts.
9. Equity and local economy: Creating bioregional economies that support fair employment, inclusive communities and international fair trade.
10. Health and happiness: Encouraging active, sociable, meaningful lives to promote good health and well being.

After the action plan is completed, a technical review panel from One Planet Community will make recommendations to the plan. If a community would like to become an endorsed One Planet Community, then the updated action plan is implemented in coordination with a One Planet advisor who works with the team to put into practice to strategies and targets outlined in the action plan. One Planet works with endorsed partners to review progress annually and make updates to the action plan as necessary.

One Planet Communities seeks opportunities to work with tribal or indigenous communities around the world and their principles are well-aligned with the goals of Thunder Valley CDC for a Regenerative Community Development. The model of self sufficiency embodied in this development has the potential to ripple out to the larger Lakota Nation and inform solutions for: high quality affordable housing, innovative economic opportunities, environmental revitalization, strengthened life long education processes, and healthy living based in traditional practices and cultural values. With access to a global network through One Planet Communities, this model may increase its capacity to inform and inspire other First Nations communities around the world.



Example images of community benefits (top to bottom): Self-sufficient construction skills;
Healthy food grown on site and classes in nutrition and healthy food preparation

Example images of community benefits (top to bottom): Community garden - all ages participation; Workforce training in construction; Efficient, affordable homes in a walkable community

Example images of community benefits (top to bottom): Cultivating a creative and artistic community with artist studio space; Educational signage on applied research; Central market space

Example images of community benefits (top to bottom): Life long learning opportunities for job training; Grow and sell local products; Tutoring, knowledge/culture sharing in formal and informal community settings between all ages

In partnership with

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