

David Kahn Studio

3447 Eldorado Springs Drive Box 228

Eldorado Springs, Colorado 80025

303.499.9887

david@kahn.com

Project Statement:

Geos will be the largest net-zero energy, urban mixed-use neighborhood in the United States. Earth and sun power will completely sustain the community's energy needs, and replace all fossil fuels. The neighborhood is intertwined with natural systems, stormwater fed landscapes, and civic places. Rain and snow melt feed street tree rain gardens, percolation parks, plazas, and community gardens. Geos received final development approval from the City of Arvada and will begin construction in Summer, 2009.

Project Narrative:

Introduction

The Geos Neighborhood incorporates symbiotic relationships in site planning and architecture, at all scales. Urban density is optimized with passive solar access. Stormwater is integrated and omnipresent within the neighborhood layout. Energy is generated from ground source heat networks and photovoltaics on every rooftop. The architecture utilizes high performance building envelopes and super efficient mechanical systems. The overall town plan aims to foster bio-civic relationships with natural processes, neighborhood ecology, and environmental stewardship.

Project Data

Total Acreage:	25.2 acres
Number of Residential Units:	282
Net Density:	23.2 Dwelling Units/Acre
Commercial Square Footage:	12,000 sf - neighborhood service oriented
Civic Buildings:	CoHousing Community House on Central Square
Parks & Open Space:	8.5 acres – 34% of site includes: Percolation Parks with fruit tree co-ops, gardens, play areas. Town Squares with civic amenities, play grounds, event spaces. Mixed Use Meadow with native habitat, active & passive use areas, and agriculture.
Energy Systems:	1.3 Megawatt PV System; 5,000,000 BTU Geothermal System CARBON FREE - NO FOSSIL FUELS
Process:	2004-2007 Development Plan and Sustainable Mixed Use Design Code Completed. 2007 Planning Commission and City Council Approval. 2008 Planning Staff Approval of Construction Documents. 2009-2010 Phase 1 Construction. 2010-2012 Phase 2 and 3 Construction.
LEED Status:	Qualifies for LEED-ND (Neighborhood Design) at Silver Level.

Net - Zero Energy Site Planning

Net - Zero refers to energy production equal to the amount consumed. The key to creating a dense net-zero energy neighborhood in Colorado's climate is to maximize passive solar access to all buildings and dwellings. This begins with the layout of streets, alleys, blocks, and parcels, followed by buildings and trees.

During the planning process many different street-block-parcel-building layouts were analyzed comparatively for their ability to both harvest and conserve energy. Each layout was evaluated using 3-D modeling of seasonal sun and shade patterns to discern the most efficient patterns. Energy modeling (with assistance from the National Renewable Energy Lab in Golden, Colorado) of each building and landscape design provided data on unit loads and production.

Key Strategies:

Macro Layout – Parcels and buildings are stretched east-west for maximum solar access within an urban street grid with north-south alleys and greens.

Checkerboard Layout – Buildings are spaced and staggered for solar access.

Geothermal Loop Fields integrated within open space and utility networks.

Photovoltaics on every rooftop; Solar Thermal supplements Geothermal.

Deciduous tree species, heights, and placement selected to assure both solar access to photovoltaics, and passive microclimate cooling.

High performance passive solar buildings with air tight envelopes and heat recovery ventilation systems. Apertures to north are minimized, east and west apertures are controlled and shaded.

Civic Stormwater Planning

Stormwater is both precious and dangerous in Colorado's arid climate. Conventional Colorado developments typically detain flash flood and monsoon runoff in large unusable detention basins, fenced off from the public realm. The key to integrating stormwater with public experience is to mimic predevelopment conditions by distributing runoff throughout the site. Decentralized detention allows for the design of a tributary system of site specific, multiple use environments.

During the design process many models of stormwater management were analyzed for the ability to detain the 100 year flood on site, and slowly release it in 24 hours. With assistance from the Denver Regional Urban Drainage & Flood Control District, and the Jefferson County Stormwater Quality Coordinator, each layout was evaluated for its capability to combine both stormwater and civic functions. The morphology of water quality, detention volumes, and reduced time of concentration would form the armature for the community's pedestrian, park, and plaza network.

Key Strategies:

Conceive of stormwater management holistically and at all scales.

Permeable paving for water infiltration is used for all pedestrian ways and plazas.

Street Tree Rain Gardens receive, detain, and filter surface runoff from streets, alleys, and the surrounding environment, while irrigating streetscape plantings. They minimize directly connected impervious areas, reduce time of runoff concentration, while utilizing infiltration, evaporation, and evapotranspiration.

Civic Stormwater Planning – Key Strategies, cont.

Percolation Parks are stormwater detention basins designed as mixed-use parks and plazas. By mimicking predevelopment stormwater dispersal patterns they reduce the size and extent of the storm sewer system. Percolation Parks feature neighborhood amenities, urban agriculture, and wildlife habitat. They are placed prominently in the neighborhood and provide ease of access, human scale, and a diversity of uses.

Localized Rain Gardens are integrated on every parcel through out the neighborhood, from mixed-use courtyards to residential yards. They receive runoff from paving and rooftops, providing an intimate experience of stormwater management.

Level Outlet Spreaders slowly release outflows to the floodway, mimicking predevelopment sheet flow, and eliminating the need for riprap erosion control.

Planning for Urban Stewardship: Empowering Residents to “Be the Resource”

The aims of Net-Zero Energy and Civic Stormwater serve a larger goal - to foster stewardship in the neighborhood, and enable residents to take active roles in managing their resources and environment. This can fold into participation in the social life and governance of the community.

Planning for Goes involves many socially oriented features. A dense layout of varied housing options provides for diversity and affordability. A prolific pedestrian network of pathways, parks, and civic spaces is anchored by mail box kiosks, play areas, and gathering spaces for all occasions, large and small. All paths lead to the Ralston Creek Regional Greenway that connects to schools, recreation centers, and urban centers.

Processes of nature and agriculture are interwoven with civic and community life. Common greens are surrounded by fruit tree terraces, to be maintained and harvested by the adjacent homeowners. Community gardens and composting areas are dispersed throughout the site. All private yards receive great sunlight and are semi-enclosed like courtyards. Gutters and downspouts form tributaries to raingardens in each resident's landscape.

Key Strategies:

Integrate natural systems and processes within the fabric of everyday life. Mix stormwater management, food production, and biotic habitat with public pathways, parks, and civic spaces. Create complex mutually beneficial networks of unique ecosystems, each adapted for specific conditions.

Give residents opportunities to play active roles in managing their resources, and caring for their environments.

Provide agricultural opportunities through out the neighborhood, and at a diversity of scales; from pocket community gardens and orchards in each sub area, to larger Community Supported Agriculture.

Fruit Tree Terraces, Property Line Planting Strips, and Landscape Foyers unite the pedestrian realm while enfranchising residents to personalize their environment.

An Energy Systems Guide and Xeriscape Plant and Landscape Maintenance Manuals provide residents with detailed information on indoor and outdoor stewardship.

Working with the local municipality and surrounding neighborhoods to identify and provide eco-amenities that serve the larger community.

GEOS *NET-ZERO ENERGY MIXED-USE NEIGHBORHOOD*



IEWS FROM REGIONAL GREENWAY

GEOS NET-ZERO ENERGY MIXED-USE NEIGHBORHOOD



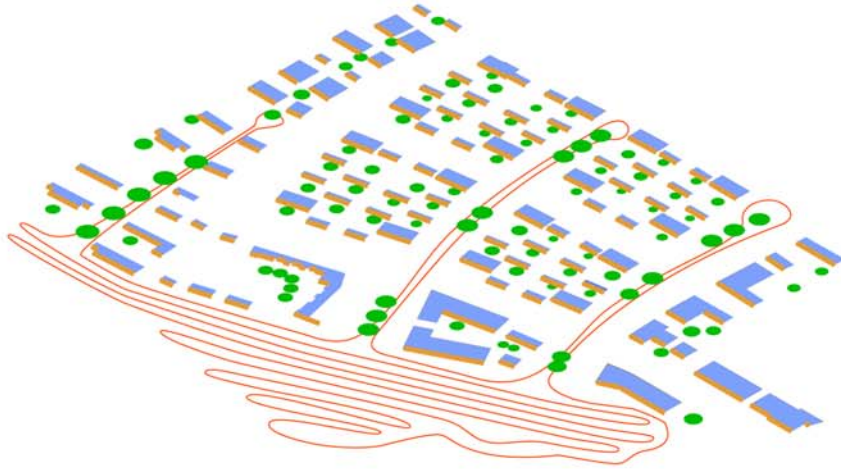
CONTEXT MAP

LAND USES:

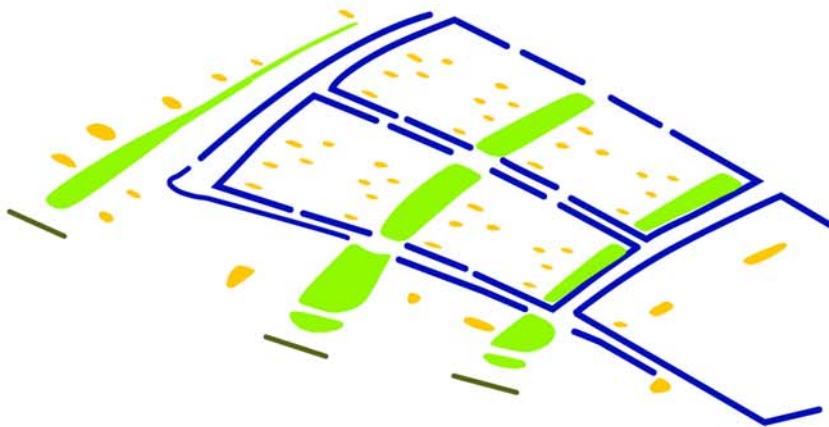
- 282 Dwelling Units, 12,000 sf of neighborhood-serving commercial:
- **Vertical Mixed-Use**
 - Residential condos over commercial space along mixed-use main street
- **Live/Work**
 - Attached and detached long East-West Streets.
- **Residential**
 - Compact homes and live/works range in size from 800 sf to 2,100 sf.
 - Home types include small-lot Single Family, Duplexes and Townhomes, Live/Work and Condos, Carriage units.
 - Inter-generational and senior cohousing, with common house shared with community

KEY CONCEPTS:

- **Net Zero Energy**
 - Lot/Block/Building typologies optimize solar orientation with urban density. In this arrangement, buildings are stretched out east to west, apertures to the north are minimized, east and west apertures are controlled and shaded, and many homes are placed in a checkerboard layout.
 - No fossil fuels, no natural gas, provided to the site.
 - Ground source heat provided through a horizontal loop field.
 - Solar Thermal utilized where homes are not close to the loop field.
 - Photovoltaics on every roof.
 - Deciduous trees selected so that they do not shade photovoltaic panels in winter.
 - High performance passive solar homes with air-tight envelopes and heat recovery ventilators (aka "Passive House.")
- **Integrated Stormwater Management ("Low Impact Development")**
 - "Rain gardens" integrated into every yard.
 - "Street Tree Rain Gardens," between sidewalk and curb, filter runoff while irrigating street trees.
 - "Percolation Parks" threaded through the neighborhood as common greens. These are usable, "mixed-use" greens that support urban agriculture, child play, and wildlife habitat.
 - The neighborhood is applying to be part of a state pilot program to test the impact of small rainwater cisterns.
- **Urban Stewardship: "Be the resource"**
 - Integrate contact with natural resources into private and community life.
 - Integrate agriculture via private gardens, fruit tree coops around each common green, and community gardens. Provide convenient amenities for composting.
 - A diverse public space network is intended to encourage walking while fostering a complexity of human and natural relationships amongst many age groups.
 - Design regulations and maintenance manuals describe resource management practices for residents.



- Geothermal Loops —
- Rooftop Photo Voltaic Panels ■
- Passive Solar Surfaces ■
- Summer Shade Trees ●



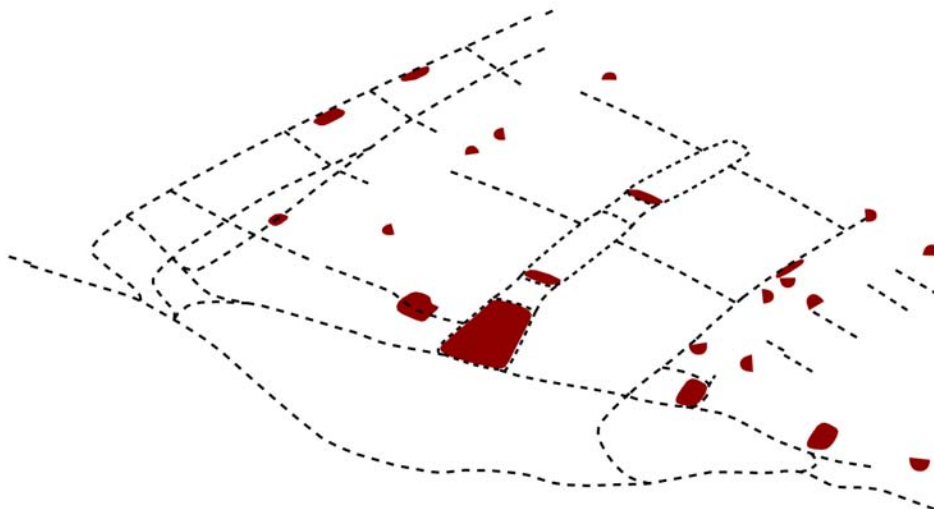
- Street Tree Rain Gardens —
- Percolation Parks ■
- Private Rain Gardens ■
- Level Outlet Spreaders —



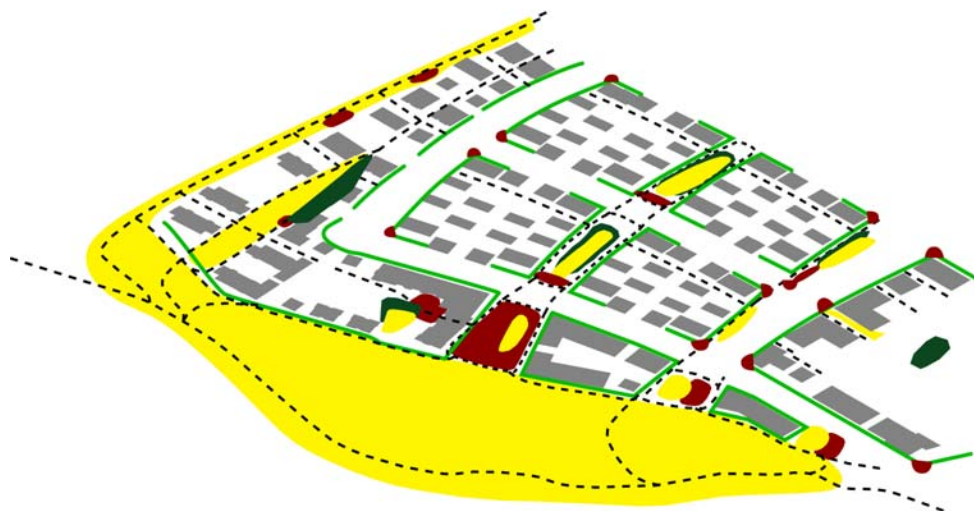
- Street Tree Rain Gardens —
- Percolation Parks ■
- Private Rain Gardens ■
- Level Outlet Spreaders —
- Cottonwood Riparian Zone ■
- Ralston Creek —
- Croke Canal —



- Community Gardens and Fruit Tree Terraces ■
- Mixed-Use Meadows: "Kids, Crops, and Critters" ■
- Property Line Planting Strip "Hedgerow Geneity" ■



- Pedestrian percolation - - -
- Civic Space: Eat, Drink, and be Merry ■



- Pedestrian percolation - - -
- Mixed-Use Meadows: "Kids, Crops, and Critters" ■
- Property Line Planting Strip "Hedgerow Geneity" ■
- Civic Space: Eat, Drink, and be Merry ■
- Community Gardens and Fruit Tree Terraces ■

GEOS

HISTORIC DENVER
DEVELOPMENT PATTERNS
FORMED THE BASIS FOR
SOLAR INNOVATIONS

OPTIMIZE DENSITY WITH SOLAR ACCESS

- CORNER STORES
- NORTH-SOUTH ALLEYS
SUPPORT SNOW MELT
- PARKING AT ALLEYS
AND ON-STREET
- MINIMAL SETBACKS,
MINIMAL SIDE YARDS
- SINGLE FAMILY
AND DUPLEXES
ON NARROW 25' LOTS
- TOWNHOMES AT
ENDS OF BLOCK

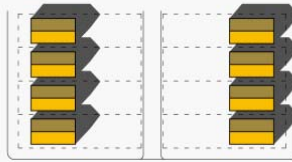


INTERNATIONAL PRECEDENTS
PROVIDED ALTERNATE TYPOLOGIES

DENVER, USA



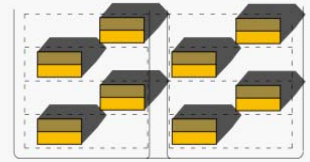
- Narrow lots
- North-South alleys



TRANSFORMATION

THE DENVER
ALLEY HOUSE

- Checkerboard solar access



ASUNCION, PARAGUAY



- Zero lot line homes
- Rear walled courtyards



TRANSFORMATION

THE SOUTH AMERICAN
ZERO LOT LINE HOUSE

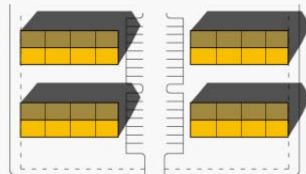
- Minimize side yards
- Treat outdoor spaces as courts



BERLIN, GERMANY



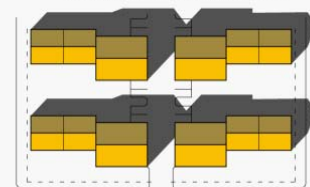
- Townhomes with remote parking



TRANSFORMATION

THE NORTHERN EUROPEAN
WIDE TOWNHOUSE WITH
REMOTE PARKING AND SUNNY
YARDS FACING THE PUBLIC


- Extra-wide townhomes for solar access
- Tuck-under live/work townhomes
- Through-block pedestrian circulation



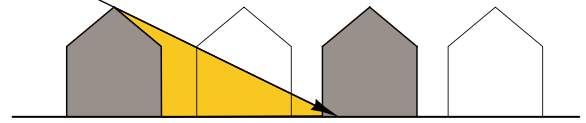
- DENSITY SUPPORTS:
- ENERGY CONSERVATION
 - MIXED-USE URBANISM
 - AFFORDABILITY

- OPTIMUM SOLAR ORIENTATION
SUPPORTS:
- PASSIVE HEATING AND COOLING
 - NET-ZERO ENERGY CONSUMPTION

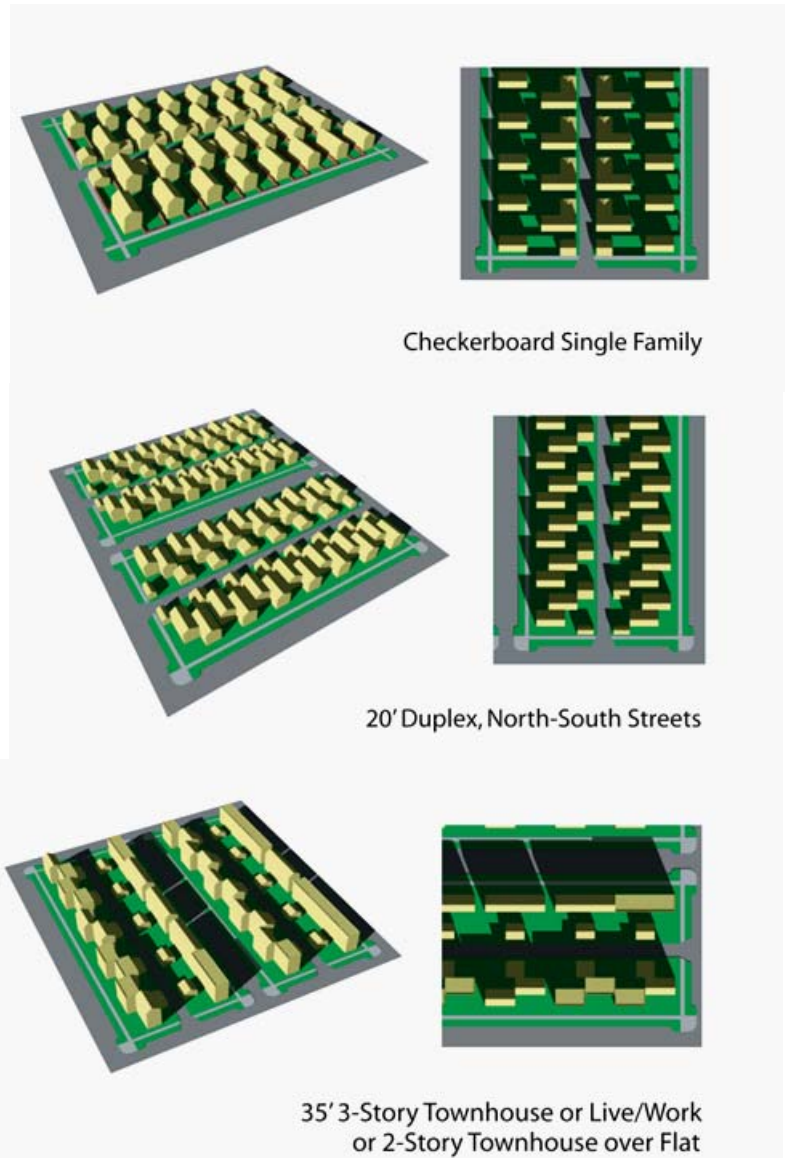
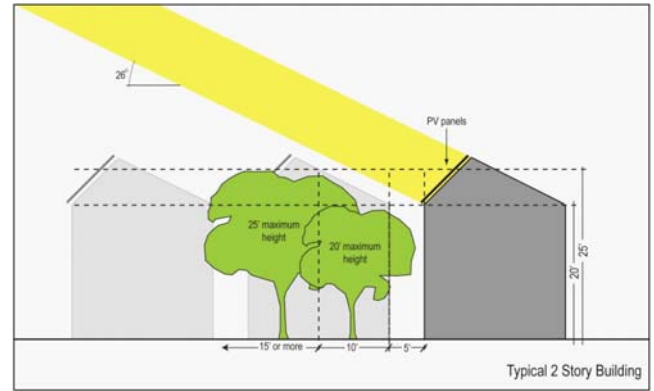
EUROPEAN AND SOUTH AMERICAN HOME TYPES INFORMED
INNOVATIONS FOR SOLAR ORIENTATION

December 21 

HOMES SPACED-APART FOR WINTER PASSIVE SOLAR GAIN



THE SHADOW CAST BY ONE TREE BRANCH IN WINTER CAN DROP THE PERFORMANCE OF AN ENTIRE STRING OF PHOTOVOLTAIC PANELS. DESIGN REGULATIONS COORDINATE TREE HEIGHTS WITH PRESERVATION OF ACTIVE SOLAR ACCESS.

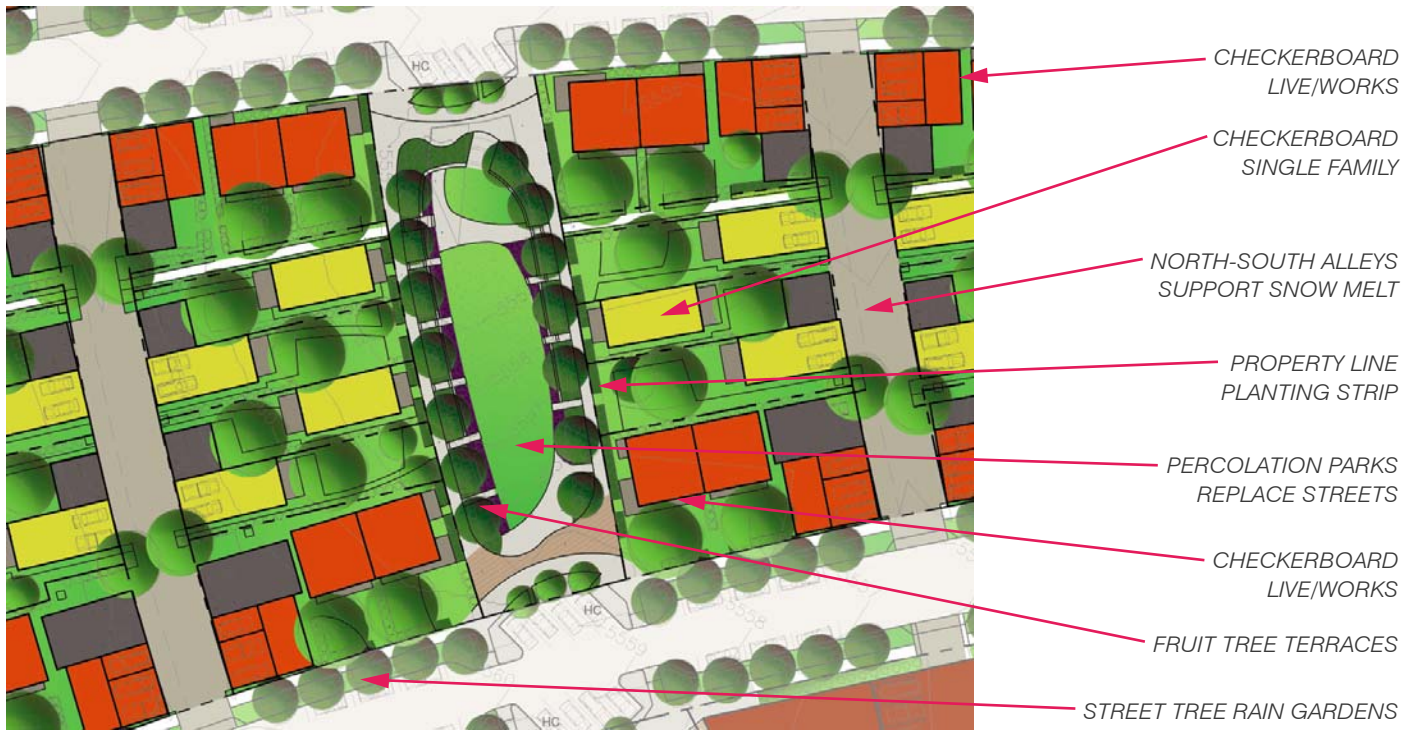


Checkerboard Single Family

20' Duplex, North-South Streets

35' 3-Story Townhouse or Live/Work or 2-Story Townhouse over Flat

WITH ASSISTANCE FROM NREL (National Renewable Energy Laboratory), DOZENS OF DEVELOPMENT PATTERNS WERE COMPARATIVELY EVALUATED FOR SOLAR ORIENTATION, PASSIVE HEATING AND COOLING, OVERALL ENERGY CONSERVATION, INTERIOR DAYLIGHTING, SNOW-MELT ON STREETS AND ALLEYS, AND GROSS URBAN DENSITY.



GEOS

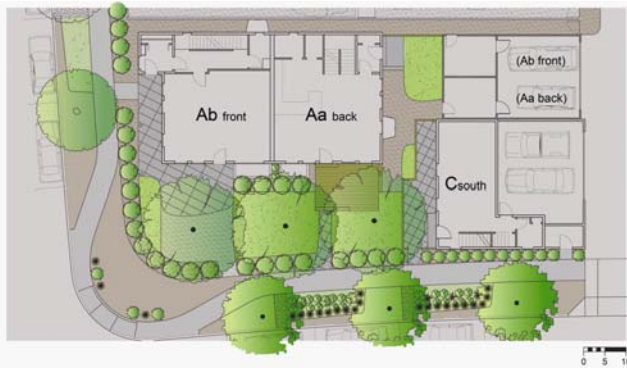
CHECKERBOARD LAYOUT FOR SOLAR ACCESS

CHECKERBOARD LIVE/WORKS

- Townhouses or live/work homes with ground level home offices
- A wide townhouse layout permits solar gain to side-by-side bedrooms or living spaces
- Homes open to sunny, south-facing yards
- Service spaces are to the north
- Doors and windows to the north are minimized
- Windows and overhangs are optimized for passive solar heating and cooling



CHECKERBOARD LIVE/WORKS



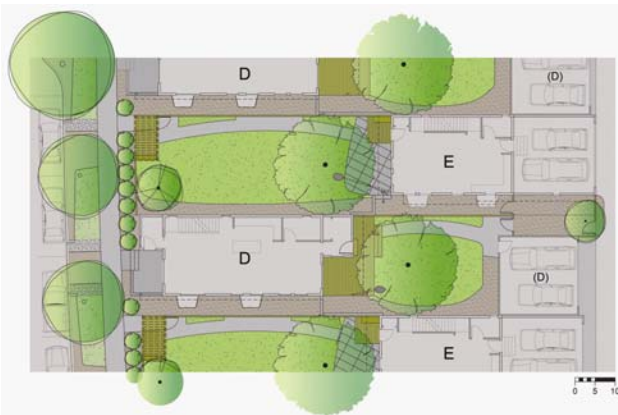
THE 4' PROPERTY LINE PLANTING STRIP FRAMES SOUTH-FACING YARDS AT THE LIVE/WORKS

CHECKERBOARD SINGLE FAMILY

- For solar access, every other home is either an alley house or at the street front
- Alternating front and back yards are shaped like courtyards
- Yards contain rain gardens that receive roof runoff
- Service spaces are to the north
- Doors and windows to the north are minimized
- Windows and overhangs are optimized for passive solar heating and cooling



CHECKERBOARD SINGLE FAMILY



A 4' PROPERTY LINE PLANTING STRIP, AND 'LANDSCAPE FOYERS,' UNIFY THE CHECKERBOARD STREET EDGE

GEOS

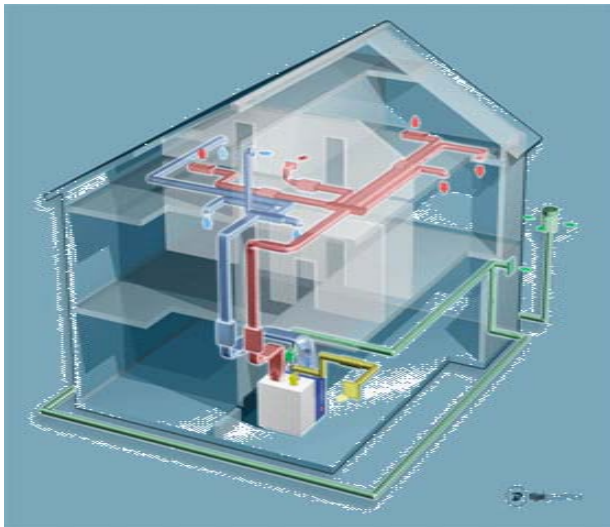
CHECKERBOARD LAYOUT FOR SOLAR ACCESS



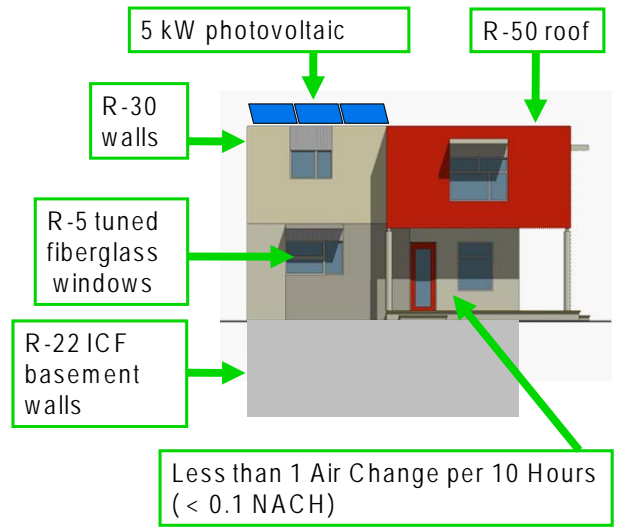
CHECKERBOARD LIVE/WORKS OPEN TO SOUTH-FACING PATIO YARDS

CHECKERBOARD ON A STREET





GEO-ASSISTED HEAT RECOVERY VENTILATOR



HIGH PERFORMANCE BUILDING SHELL

THE "PASSIVE HOUSE"

- **Passive Solar Orientation** *Reduces Natural Gas Use by 30%*
 - Stretch buildings and homes out east to west
 - Minimize apertures to north
 - Solar overhangs on south
 - Deep porches and deciduous trees at east and west
- **High Performance Building Shell** *Reduces Natural Gas Use by 40%*
 - Air Tight -- less than 0.1 Natural Air Changes per Hour
 - SIPs construction with R-50 Roofs, R-30 Walls, R-5 Windows
- **Geo-Assisted Heat Recovery Ventilator** *Reduces Natural Gas Use by 10%*
 - No Furnace needed for the passive house. HRV does the job
 - Constant Fresh Air with minimal energy loss
 - Earth Tubes further temper incoming fresh air and provide cooling
- **Geo-Thermal and Solar Thermal** *Reduces Natural Gas Use by 20%*
 - For Heating, Hot Water
 - Solar Thermal Heat for homes more than one block from loop field
- **No Natural Gas Needed; Therefore, No Natural Gas Lines**
- **Solar Photovoltaic Panels Generate 100% of Electricity Needs**
 - 5KW system per home
 - The passive home uses 35% less electricity
 - Photovoltaics panels offset the remaining 65% of consumption
 - Neighborhood is grid-tied. Electricity Consumption is Net-Zero.
- **Making Net-Zero Cost Neutral**
 - Green Technologies add \$285 to monthly mortgage
 - Energy Savings \$200/month
 - Tax savings on mortgage interest \$85/month



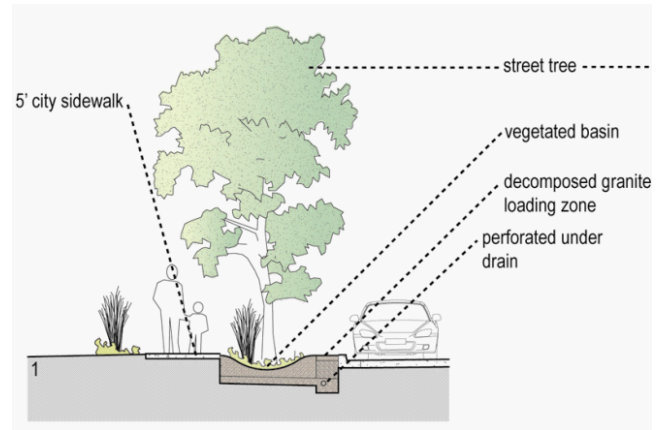
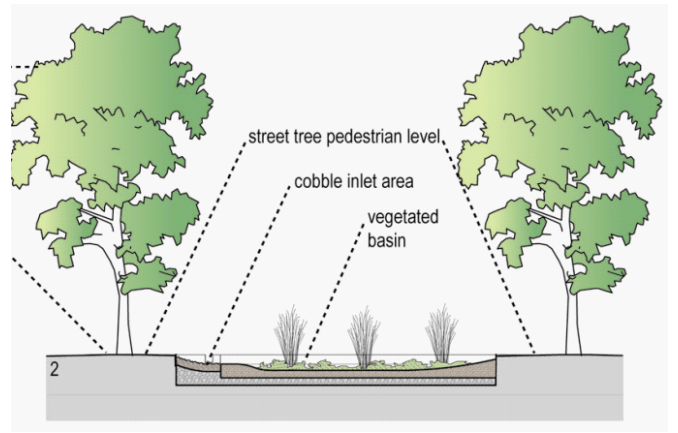
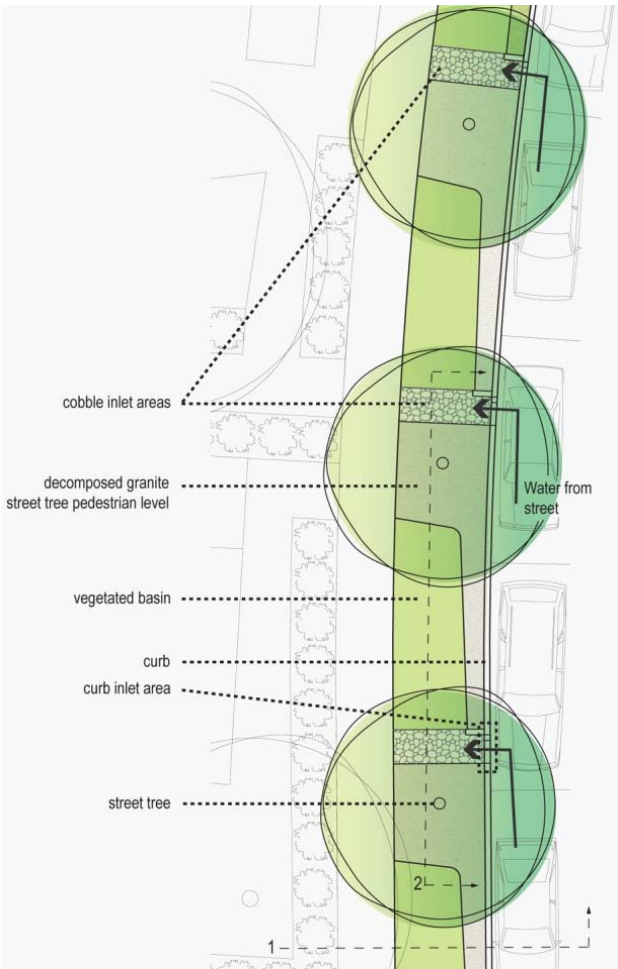


STREET TREE RAIN GARDENS AND PROPERTY LINE PLANTING STRIP FRAME THE PUBLIC SIDEWALK



GEOS

STREET TREE RAIN GARDENS



STREET TREE RAIN GARDEN WITH STORMWATER FILTRATION WHILE PASSIVELY IRRIGATING TREES

STREET TREE RAIN GARDENS FILTER RUNOFF FROM STREETS AND FROM PRIVATE PARCELS



GEOS

PERCOLATION PARKS: SQUARES



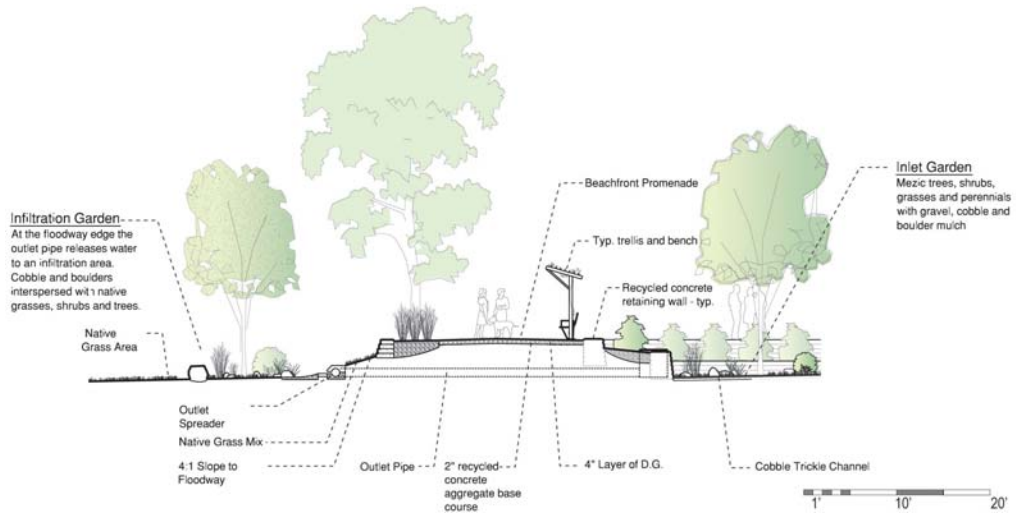
THE SQUARES ARE A COMBINATION OF NEIGHBORHOOD PARK AND STORM WATER DETENTION BASIN. THEY MUST FUNCTION TO RECEIVE DETAIN, AND OUTLET RUN-OFF FROM CITY STREETS, STREET TREE RAIN GARDENS, AND ADJACENT PROPERTIES.

THEY ALSO FUNCTION AS CIVIC OUTDOOR ROOMS: FEATURING PLAYGROUNDS, AND SPACES FOR A FARMER'S, EVENTS, AND PERFORMANCES. THE SQUARES TERMINATE AT A PROMENADE THAT OVERLOOKS THE REGIONAL GREENWAY.

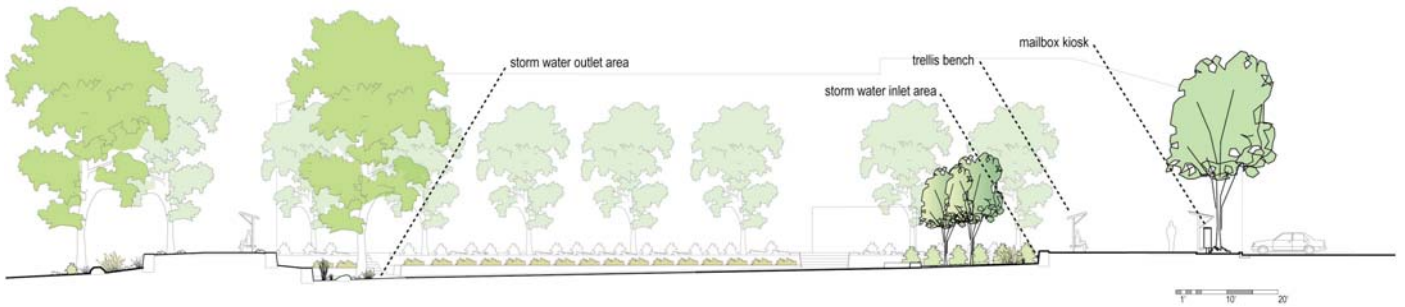


THE CENTRAL SQUARE IS FRAMED BY COMMERCIAL SPACE AND THE COHOUSING COMMON HOUSE. IT LINKS TO THE GREENWAY AND AREAS FOR COMMUNITY GARDENS AND AGRICULTURE





SECTION AT PROMENADE OVERLOOKING REGIONAL GREENWAY



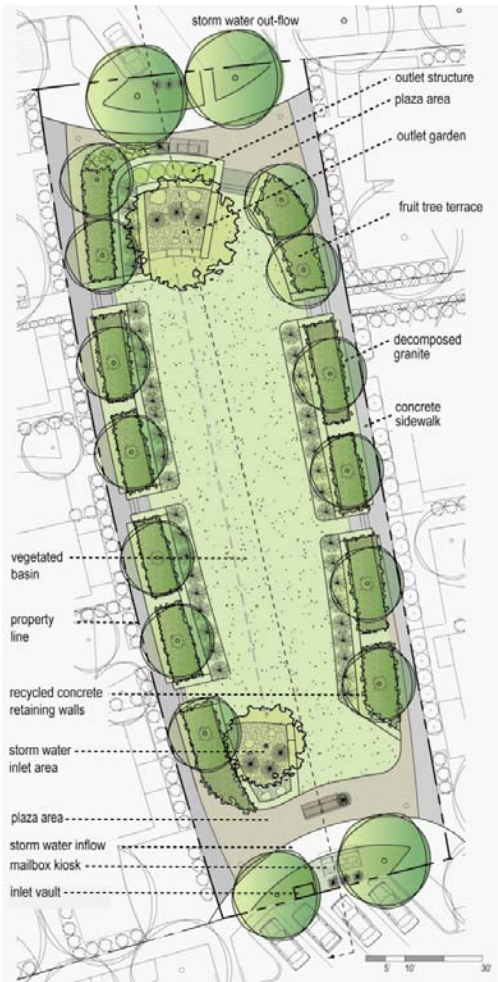
SECTION THROUGH CENTRAL SQUARE

CENTRAL SQUARE LOOKING SOUTH TOWARDS REGIONAL GREENWAY



GEOS

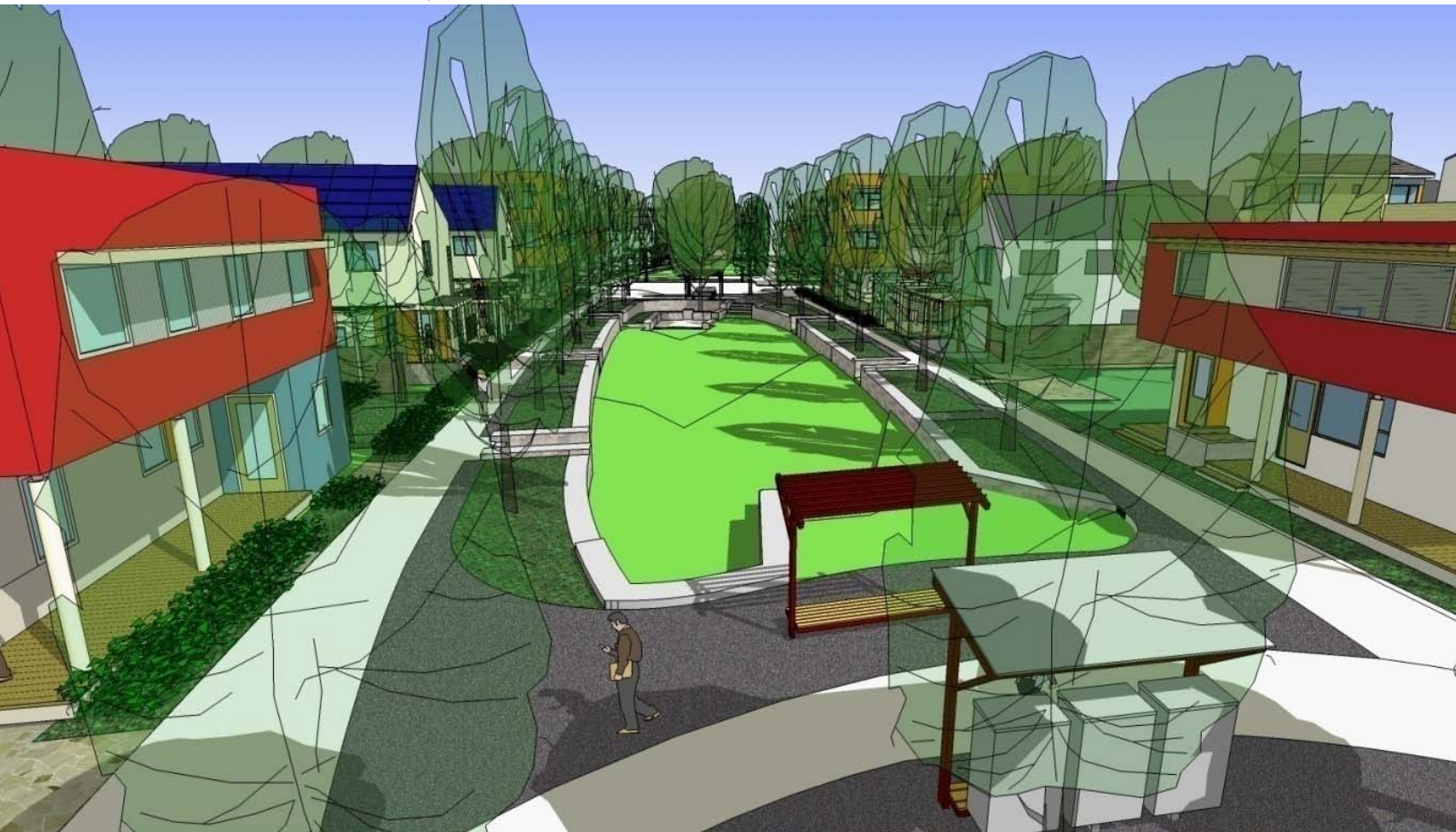
PERCOLATION PARKS: GREENS

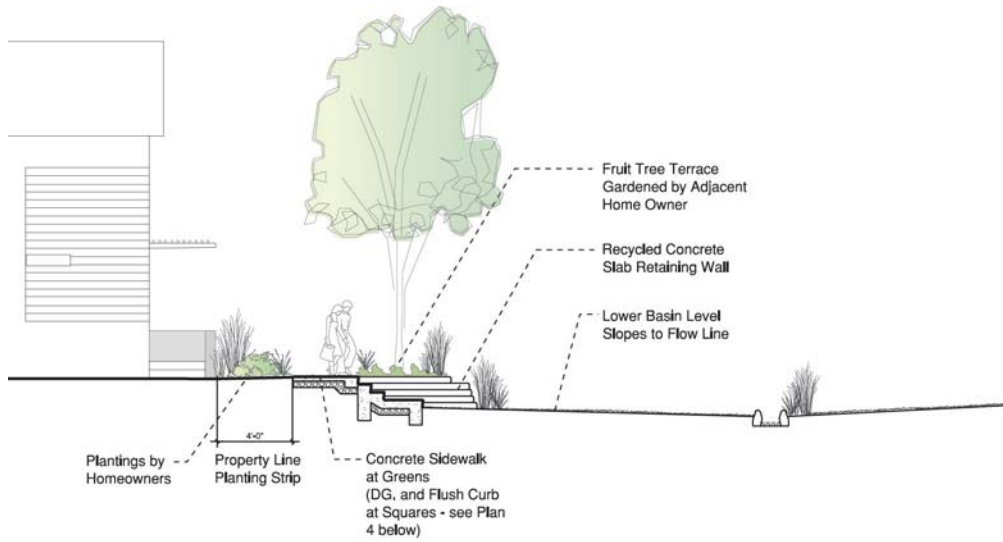


THE CHECKERBOARD GREENS COMBINE THE FUNCTIONS OF STORM WATER DETENTION BASINS AND NEIGHBORHOOD PARKS. EACH GREEN RECEIVES, DETAINS, AND OUTLETS RUN-OFF FROM CITY STREETS, STREET TREE RAIN GARDENS, AND ADJACENT PROPERTIES. IN ADDITION THEY PROVIDE A VARIETY OF OUTDOOR SPACES AND GARDENS FOR RESIDENTS OF THE COMMUNITY.

EACH GREEN INCLUDES A PEDESTRIAN ORIENTED UPPER LEVEL AND A VEGETATED LOWER BASIN LEVEL. RECYCLED CONCRETE RETAINING WALLS FORM TERRACED TRANSITIONS BETWEEN THESE LEVELS. CONCRETE STAIRS AND GRASS RAMPS PROVIDE ACCESS POINTS.

FRUIT TREE COOP ON TERRACES, AND MAIL BOX KIOSK SURROUND THE CENTRAL PERCOLATION PARK OR GREEN





THE GREENS ARE ENGINEERED TO BE HABITABLE, MULTI-FUNCTIONAL SPACES. THE FRUIT TREE TERRACES ARE TAKEN CARE OF BY ADJACENT PROPERTY OWNERS IN THE SAME WAY THAT TYPICAL TREE LAWN LANDSCAPING WOULD BE MAINTAINED BY ADJACENT OWNERS

