Harvest Waters 03_02

The Average Family

- can use 400 gallons of water per day (EPA, WaterSense)

- over 30% is used for landscape irrigation (EPA, WaterSense)

- assuming 18 families would equate to 7200 gallons of water per day with over 2100 gallons used for irrigation alone

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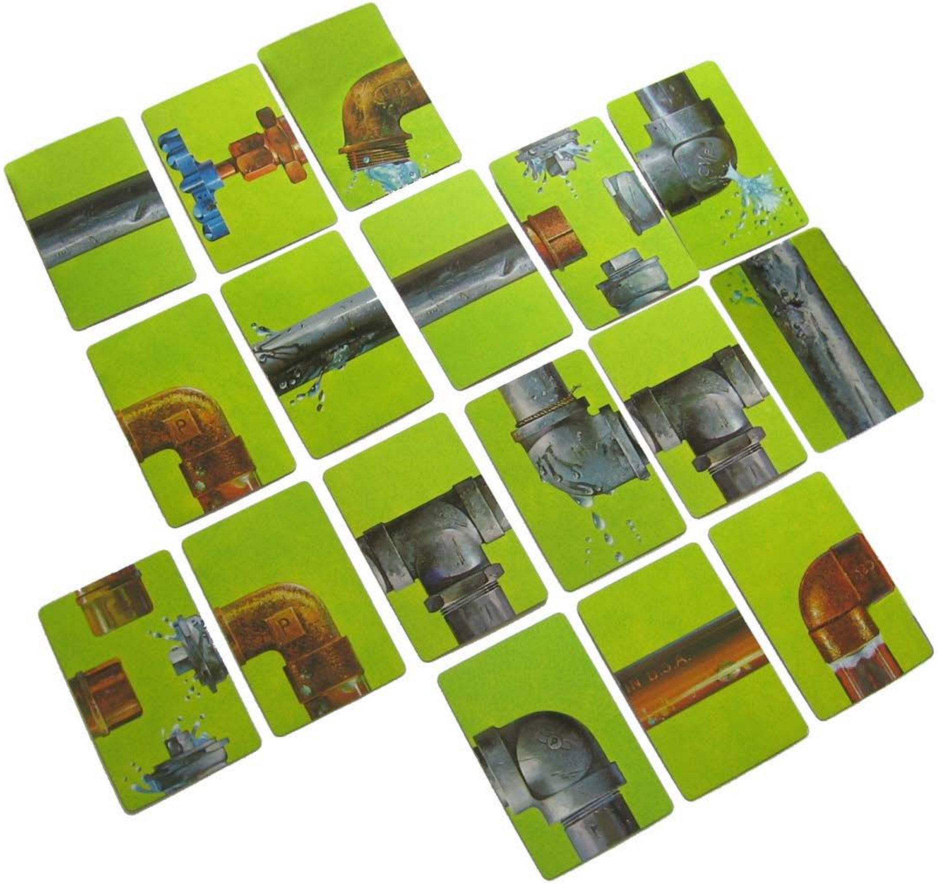
The Average Family

- in Tulsa water comes from over fifty miles away in Lake Eucha and Spavinaw Lake
- current water infrastructure is about fifty years old and was built with a fifty year life span
- over the next twenty-five years our nation will spend one trillion dollars ($1,000,000,000,000) to provide and maintain that infrastructure (AWWA, Buried No Longer)



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Context _ Project Summary

The changes to traditional residential development we propose employ currently feasible technologies and well-established construction techniques in an integrated approach to creating an extraordinary low impact development. The central feature of the design takes what was historically poorly drained grassland which with ordinary development would become even higher runoff-generating urban land with contaminated water, to **a new vision that is well-drained, purifying and that recharges the ground while making water available for harvesting on site.** This design shows the feasibility of actually retaining more water on the site than an average rainfall produces—thus virtually eliminating contribution by the development to the city's storm water system.

This new approach to site development is coupled with smart landscape design, energy saving home construction measures, and high efficiency ground source heat pump systems that work together to create a development that is both contextually sensitive and looks to the future. These mutually reinforcing goals of storm water retention and reuse, low-impact landscaping and energy efficiency can be achieved with a modest investment that yields real economic benefits to homeowners. **The end result will not appear revolutionary to the neighbors, but it will fundamentally reorient the way homeowners and the city think about the impact of residential development; from a traditional model that places more burdens on city services to one that actually reduces those burdens.**

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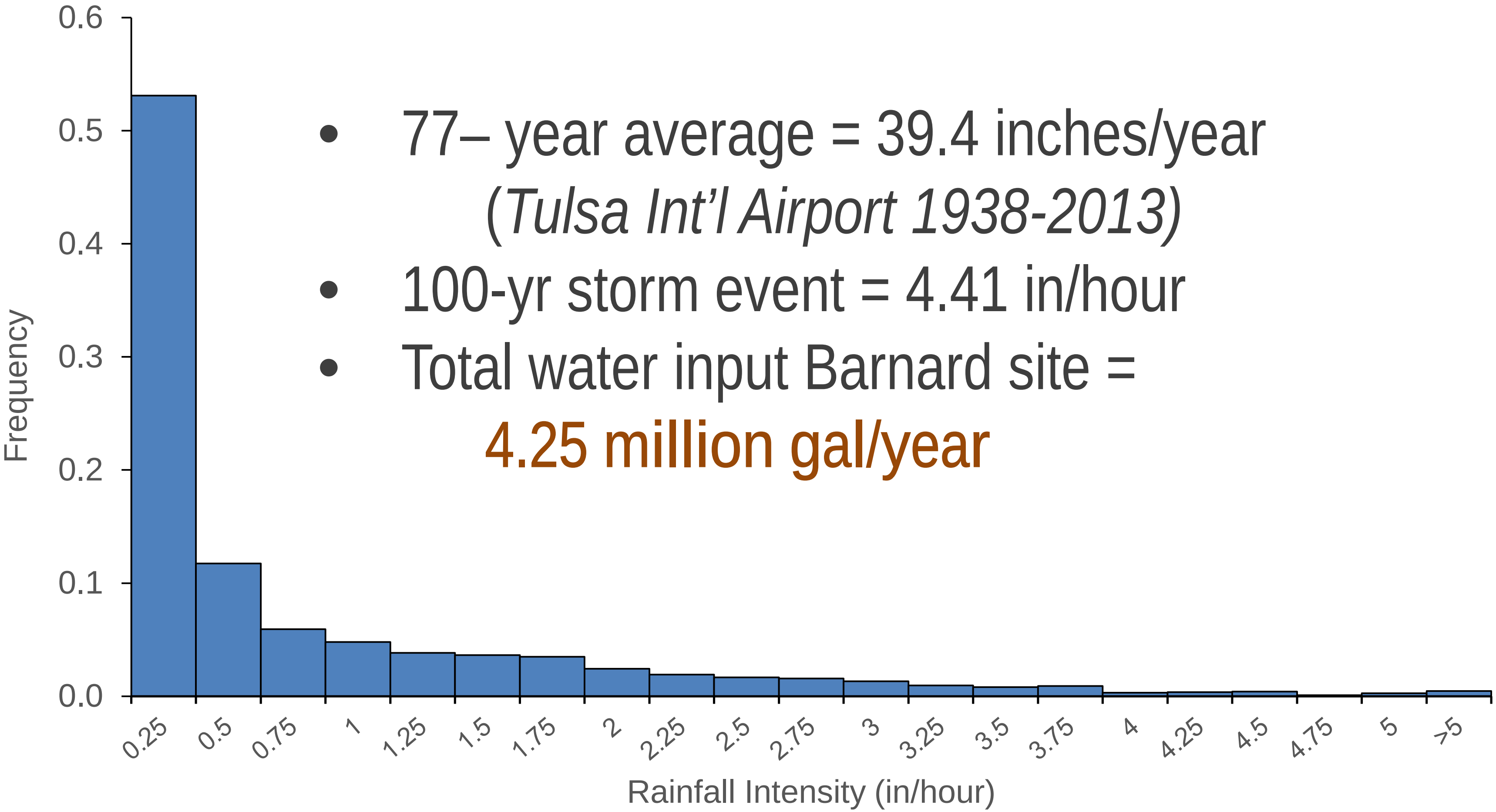
Predevelopment – millions of gallons of water did not fully infiltrate due to existing poor draining soils

Traditional Development– millions of gallons of water contaminated and then rushed to storm sewers

Context _ Rainfall



- 77– year average = 39.4 inches/year
  (*Tulsa Int'l Airport 1938-2013*)
- 100-yr storm event = 4.41 in/hour
- Total water input Barnard site =
  4.25 million gal/year

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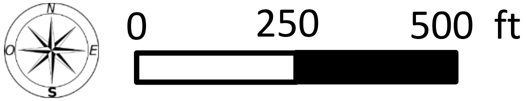
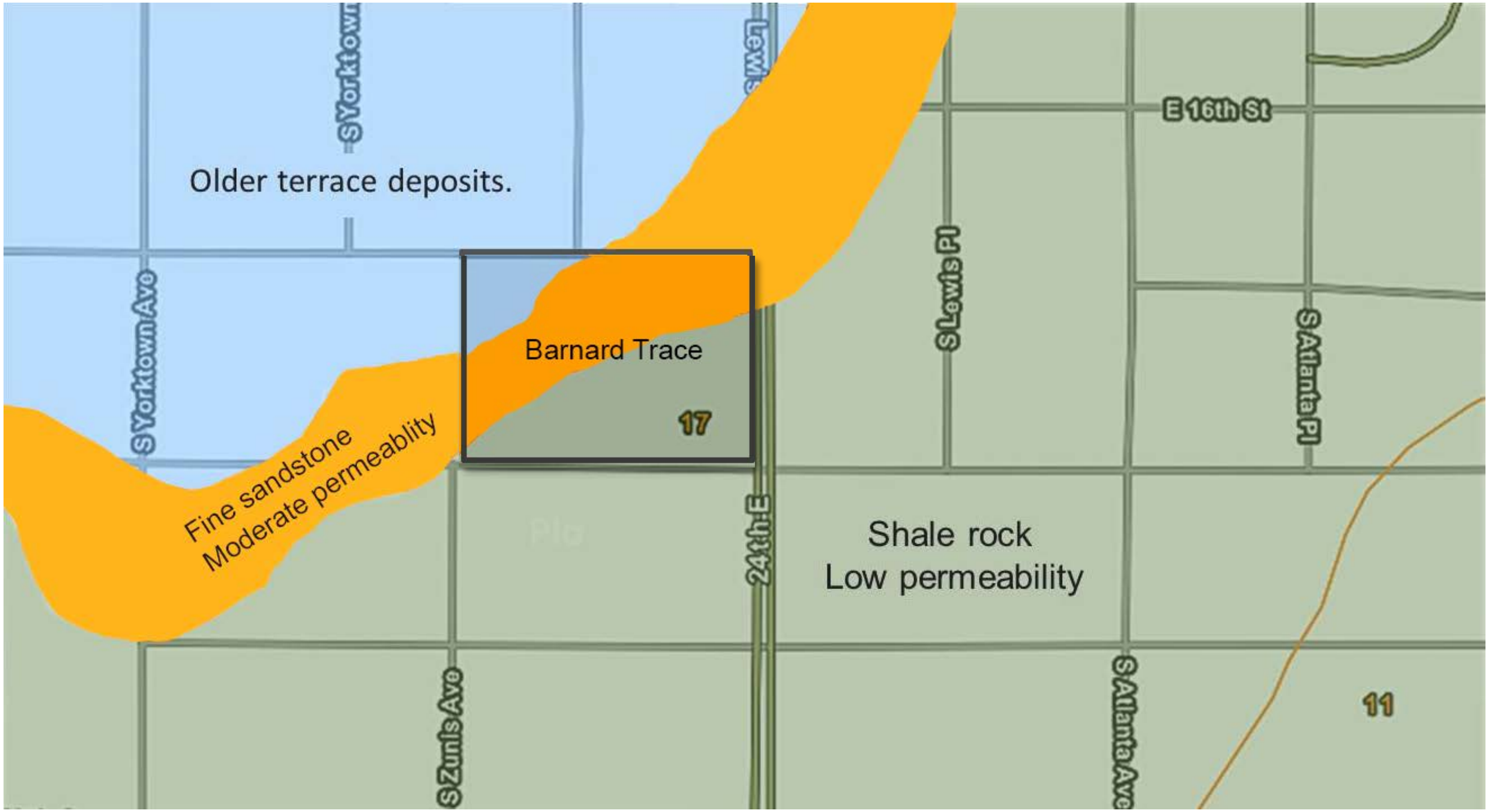
Context _ Geology





Identified as Dennis Complex soil series 17:The soil is classified as poorly drained.

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Context _ Site

challenges

- Impervious built environment over impervious soil
- Severe rainfall intensity
- Poorly draining soil
- Offsite water usage
- Dramatic drop to street
- Unknown future development of private lots

opportunities

- Historically significant masonry wall
- Interesting architectural context

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Context _ Project Goals

environmental

Low impact: collect, filter, harvest, recharge, and use the on-site stormwater runoff in order to filter, lower, and delay the peak discharge into the city’s underground stormwater network;
Environmental sustainability: make provisions for sustainable measures such as geothermal technology, daylighting design, and reuse of water

contextual

Visual character: maintaining the existing character of the surrounding neighborhood
Historical value: maintaining most of the WPA retaining walls

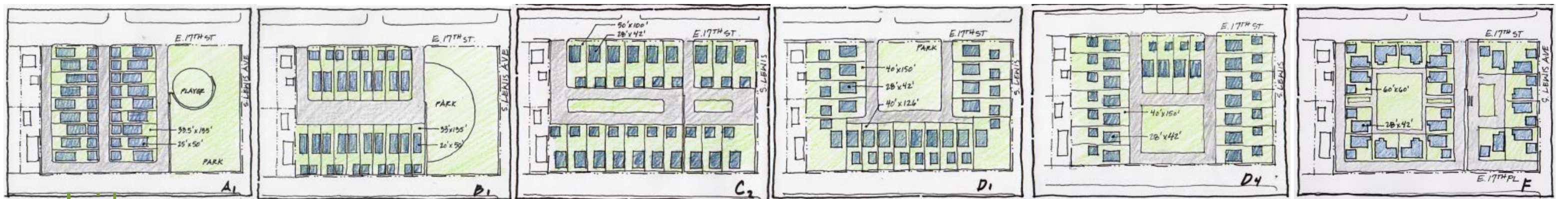
economical

Minimize cost: minimize cost of site preparation by means of utilizing the existing infrastructure, minimize dirt removal, minimize areas of street surface

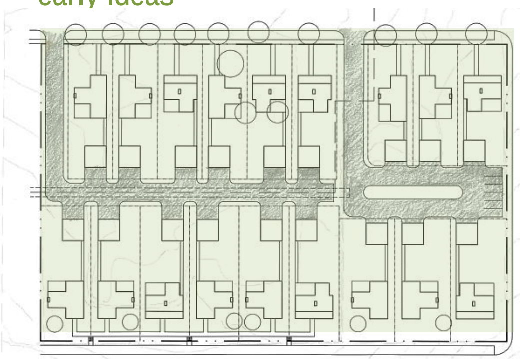
marketing

At least 18 residential lots, all of a desirable area and width
Pleasant neighborhood design: welcoming entrance, lots face major streets, detached garages in the back, discouraging through traffic, sense of a community, and smooth vehicular movement

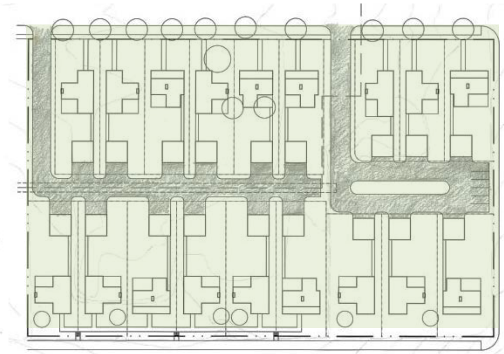
Context _ Exploration Schemes



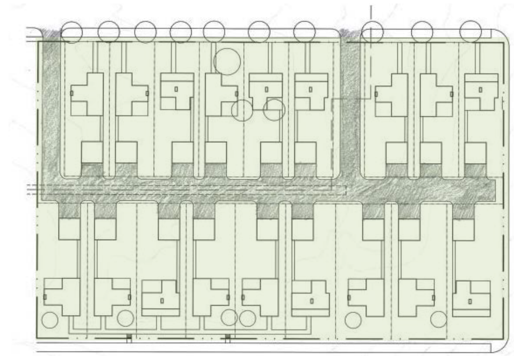
early ideas



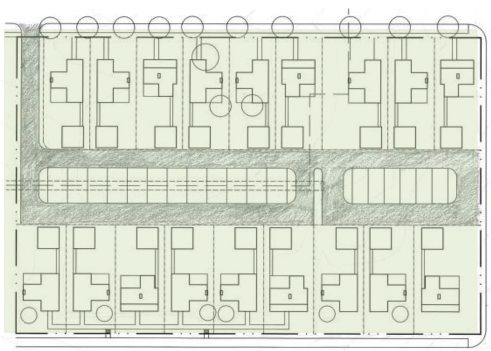
A. proposed plan- traditional



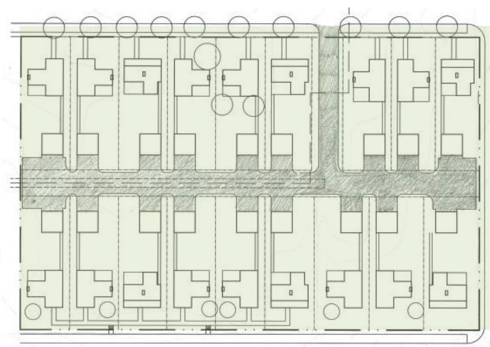
B. proposed plan- LID



C. through-drive plan- LID



D. garden plot plan- LID



E. double cul-de-sac- LID

F. grassland

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Context _ Peak Discharge Assessment

Rational Method for Estimating Peak Discharge (cfs)				
	Storm events (in/hour)			
	5-year	10-year	50-yr	100-yr
	1.32	2.16	3.72	4.41
Scenario A	2.87	4.69	8.08	9.56
Scenario B	1.70	2.79	4.80	5.68
Scenario C	1.67	2.74	4.71	5.57
Scenario D	1.71	2.80	4.82	5.70
Scenario E	1.68	2.75	4.74	5.61
Scenario F	2.11	3.45	5.94	7.03

Scenario A – Proposed plan (No changes)
Scenario B –Proposed plan (with LID)
Scenario C – Adjusted plan (Through drive)
Scenario D – Common garden plan
Scenario E – Double *cul-de-sac*
Scenario F - Grassland

Harvest Waters

Context _ Plan Alternative Assessment

Urban Residential Development

Assessment of planning alternatives

	A	B	C	D	E
Cost reduction measures					
1.1 Using the existing infrastructure	3	3	3	3	3
1.2 Preserving the historic WPA walls intact	3	3	2	2	2
1.3 Minimizing the need for moving dirt	3	3	2	2	2
1.4 Minimizing area of black top surface	2	2	3	1	3
Market value measures					
2.1 Maximizing area of sellable lots	2	2	3	1	3
2.2 Lots face major streets	3	3	3	3	3
2.3 Desirable lot sizes	3	3	3	2	3
2.4 Desirable width of lots	3	3	3	3	3
2.5 No garage doors face streets	3	3	3	3	3
2.6 Detached garages	3	3	3	3	3
Low-impact development measures					
3.1 Allowing efficient stormwater management	0	3	3	3	3
3.2 Minimizing area of black top surface (same as 1.4)	2	2	3	1	3
Neighborhood design					
4.1 Welcoming entrance	2	2	2	1	2
4.2 Discouraging through traffic	3	3	3	3	3
4.3 Sense of unified neighborhood (street design)	2	2	3	3	3
4.4 Smooth vehicular movement (including trash collection)	1	1	2	3	1
4.5 Minimizing areas of shared responsibility	3	3	3	1	3
21st Century ready					
5.1 PV-ready	3	3	3	3	3
5.2 GSHP-ready	3	3	3	3	3
5.3 Providing a community green space (conflicts with 2.1)	0	0	0	3	0
	47	50	**53**	47	52

Scoring

- 0 Does not achieve the objective
- 1 Marginally achieves the objective
- 2 Somehow achieves the objective
- 3 Successfully achieves the objective

Scenario A – Proposed plan (No changes)
Scenario B –Proposed plan (with LID)
Scenario C – Adjusted plan (Through drive)
Scenario D – Common garden plan
Scenario E – Double *cul-de-sac*
Scenario F - Grassland

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Context _ Site Progression

poorly drained soil

typical development compounding poorly draining soil with contaminated water

harvest waters development with well drained soil and water purification

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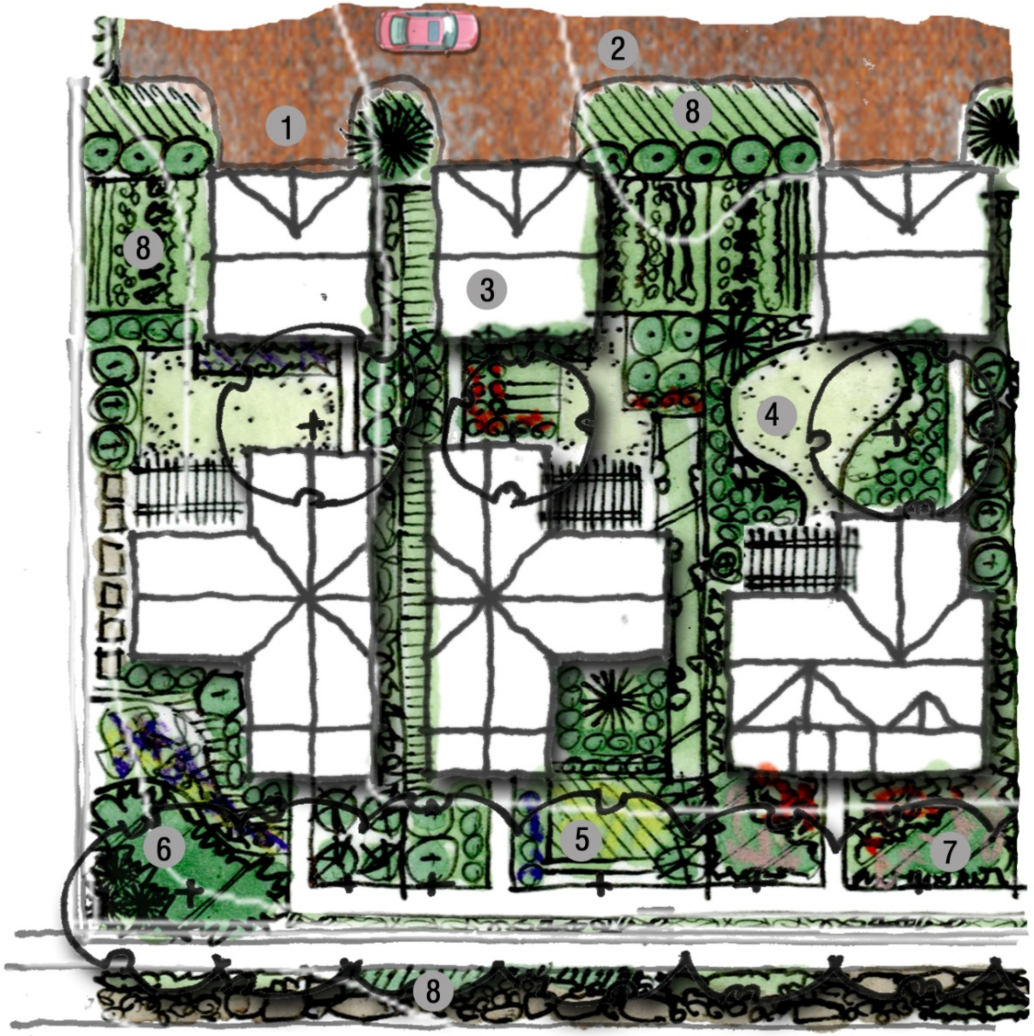
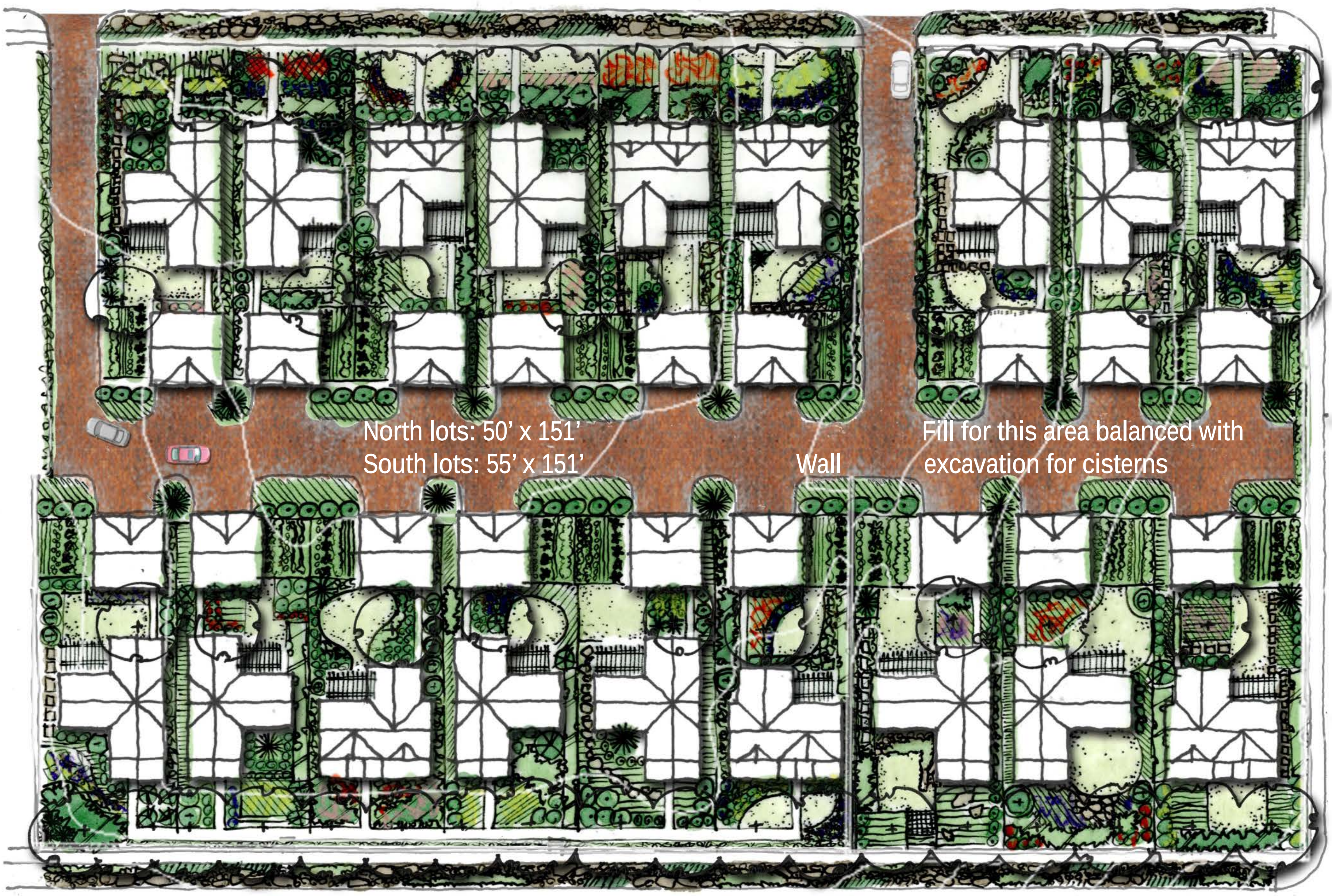
Design_ LID features (Typical)

1) water harvesting reservoirs
2) permeable paving
3) minimize footprint and paved surfaces
4) minimize turf areas
5) three trees per lot
6) increase landscape structure
7) create organic soil material
8) rain gardens

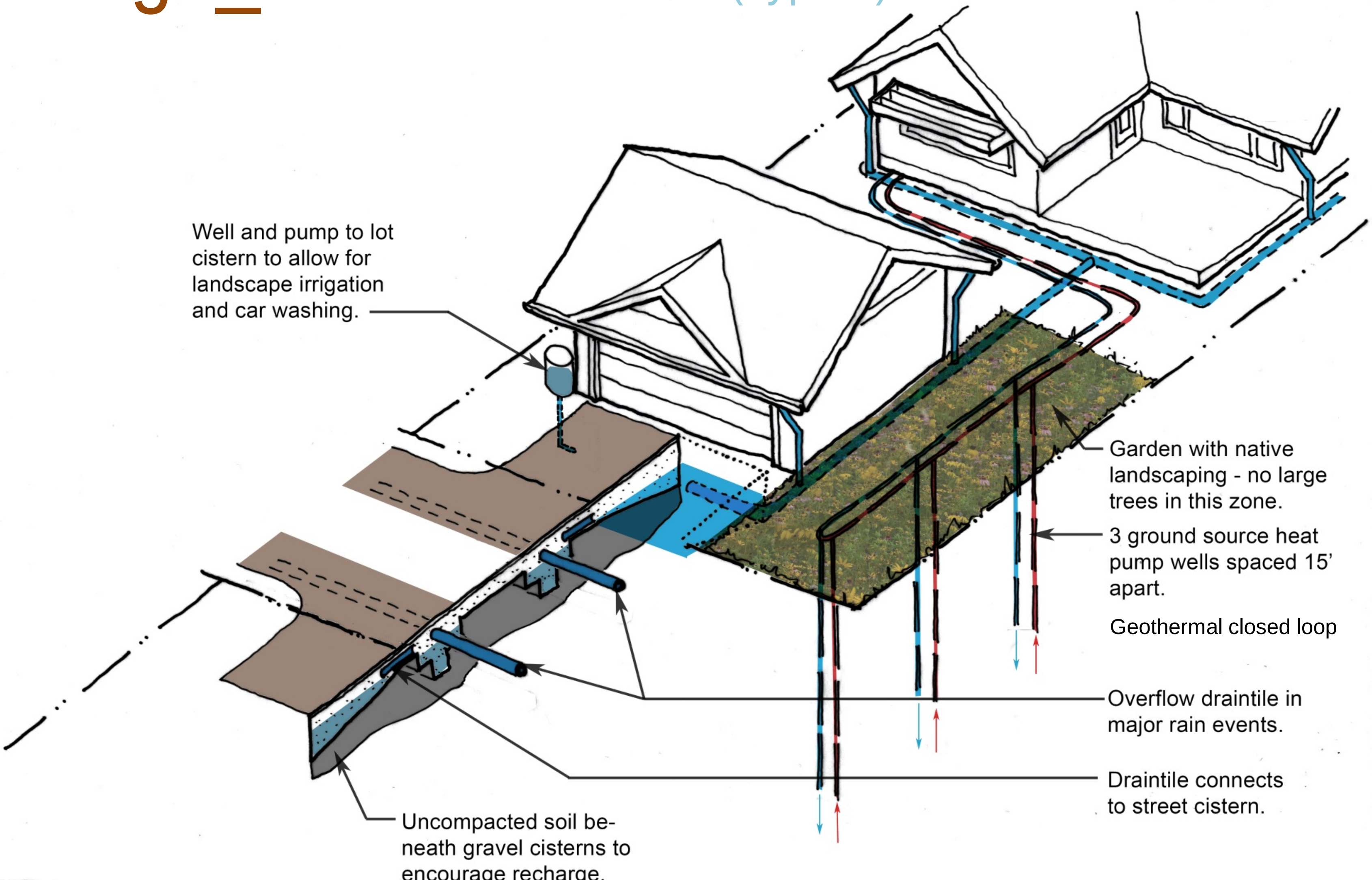


Harvest Waters [Lot Detail]

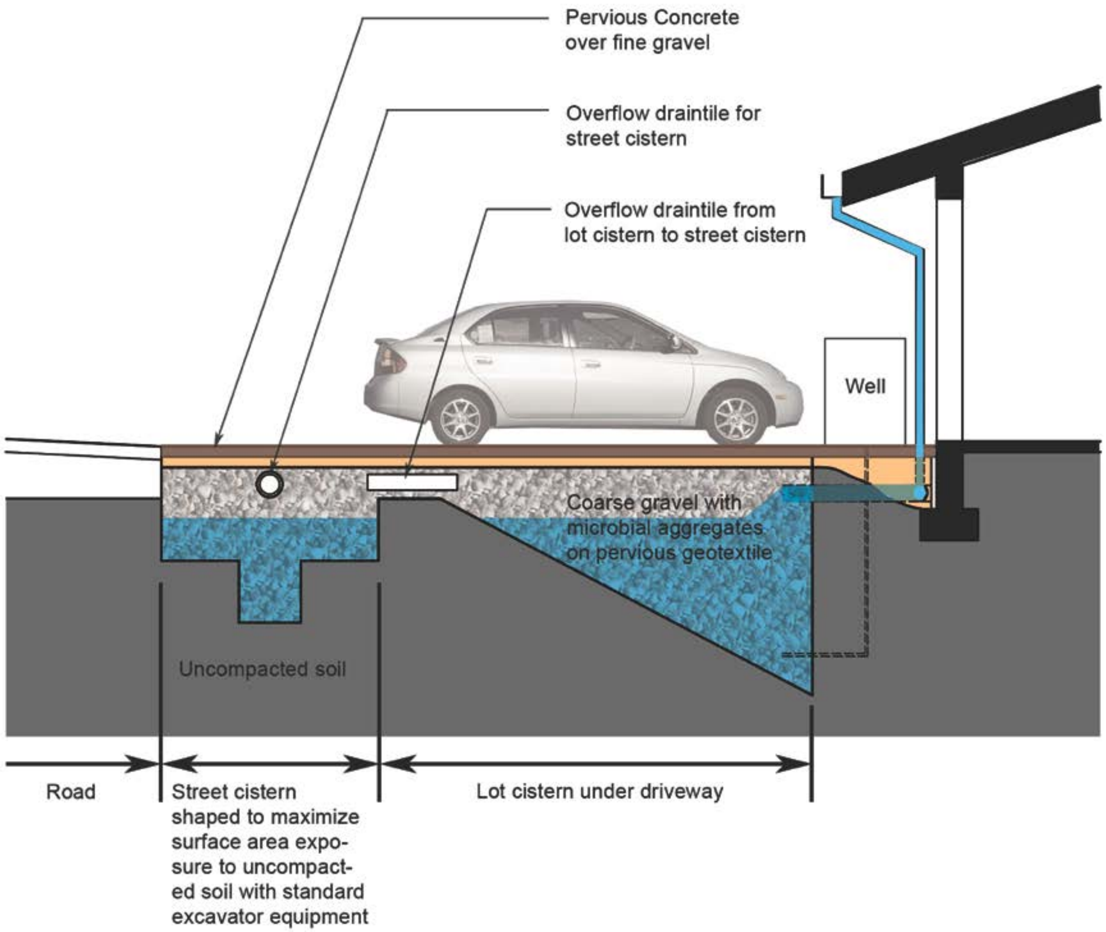


Harvest Waters [Development Plan]

Design_ LID features (Typical)



Design_ LID features (Typical)

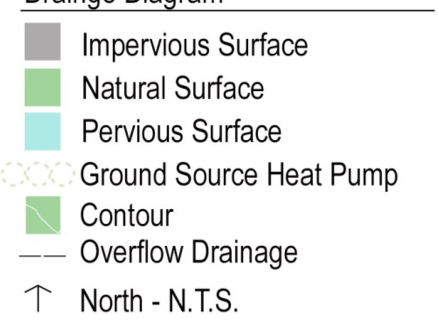


Design_ LID features (Pervious Concrete)

Harvest Waters [The New Infrastructure]

Drainage features (Typical)

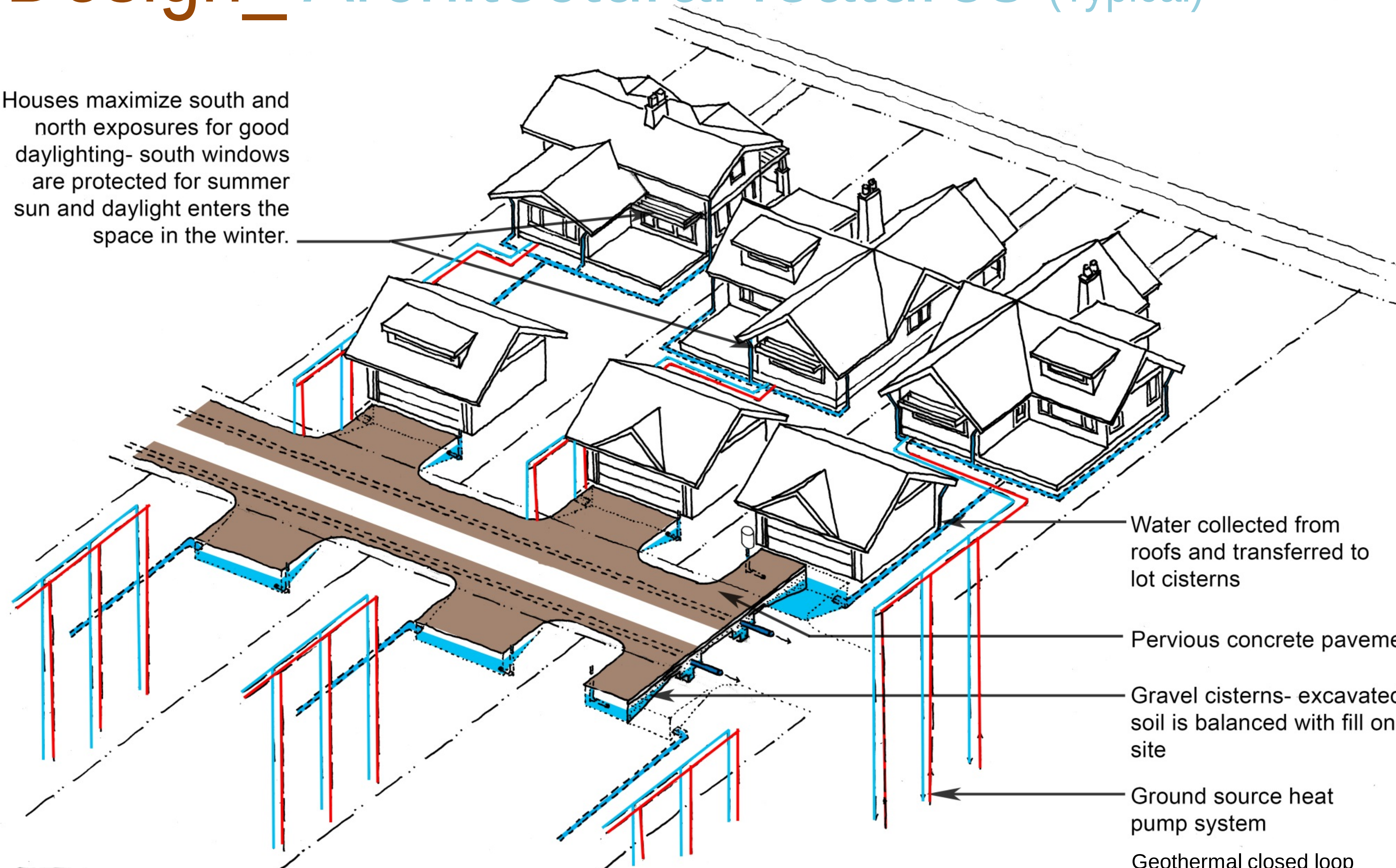
- Sufficient storage capacity to harvest a 1 inch rainfall
- Stormwater storage in a single residential lot: 8400 gal
- Total development stormwater storage: 150,000 gallons



Harvest Waters [The New Infrastructure]

Design_ Architectural features (Typical)

Houses maximize south and north exposures for good daylighting- south windows are protected for summer sun and daylight enters the space in the winter.



Water collected from roofs and transferred to lot cisterns

Pervious concrete pavement

Gravel cisterns- excavated soil is balanced with fill on site

Ground source heat pump system

Geothermal closed loop

Harvest Waters [The New Infrastructure]

Design_ Architectural features (Typical)

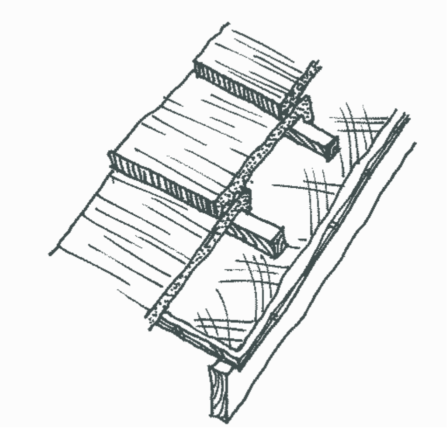
- Maximum north and south exposures capitalize on daylighting
- Deep roof overhangs reduce summer heat loads and facilitate rainwater harvesting
- Winter sun assists in heating
- Each room connects with an outdoor space
- Water collected with durable concrete roof tiles is cleaner than most options
- Each house utilizes a 3-ton ground source heat pump system and highly insulated construction of the house
- Roofs PV panel ready

Design_ Architectural features (Typical)

Concrete Tile Roof

Concrete tile is to be specified to improve the thermal performance of the roof, increase its longevity, and to make for cleaner stormwater runoff into the cisterns. The $6000/house cost of the concrete tile upgrade will be largely offset by:

- increased property values
- lower property insurance costs
- lower repair costs
- less frequent replacement
- improved thermal performance of the house



Ground Source Heat Pump System

Net cost of upgrade from conventional system: $8,000.00

Savings: $800.00 annually (7% rate of return over 20 years)

Total annual savings is $1,115.00 per home from an approximate $14,000.00 initial investment.

Design_ Project cost comparison

OLD DESIGN		NEW DESIGN	
Impervious Road and driveways	$140,000	Pervious Concrete Road and driveways	$156,000
Curb & gutter	$40,000	Curb & gutter	$0
Hauling off site	$12,600	Hauling off site	$0
Lateral drainage, catch basins & stormwater structures	$15,000	Lateral drainage, catch basins & stormwater structures	$0
Cisterns	$0	Cisterns	$120,000
Total	$207,600		276,800

The net initial cost difference is approximately $70,000 or $3,900.00 per lot.

ANNUAL SAVINGS	
30,000 x $.0083 (City of Tulsa water + sewer rate)	$250.00 / year
City stormwater annual fee per house	65.00 / year
Total annual savings	$315.00 / year

Savings:

$3,900.00 per unit cost / $315.00 = 12.3 year payback period or a rate of return of approximately 5% over 20 years.

Design_ Trees

- a mature medium sized tree will intercept over 1,000 gallons of stormwater every five years
- including other benefits a medium tree provides an average net value of over $400 per year over the course of 40 years.
- the overall value of 54 medium trees (3 trees per lot, 18 lots) over 40 years is over $850,000

(McPherson, et al)

Design_ Trees

Caddo Maple

Cedar Elm

Chinkapin Oak

Shatung Maple

Shumard Oak

Proposed Code Changes

- establish state guidance for minimum standards for stormwater recharge
- regulate amount of impervious pavement per lot
- provide incentives for stormwater harvesting by eliminating or reducing the yearly stormwater management fee
- establish a residential landscape ordinance to require a three tree per lot minimum

Harvest Waters