LOW IMPACT DEVLOPMENT

DESIGN WORK SESSION HANDBOOK

JUNE 4, 2015


ONE
WAY

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DESIGNING FOR IMPACT

The Houston-Galveston Area Council's (H-GAC) Designing for Impact project seeks to create policy recommendations and implementation tools that advance the use of LID techniques to help mitigate the negative impacts of development within the Houston-Galveston area. The project will provide designers, policymakers, and developers with tools they can use to support development that is designed, built and managed to preserve valuable natural areas and systems, allowing the region to accommodate a growing population without negatively impacting water quality and overall community health. The project also aims to provide opportunities for collaboration among designers, policymakers, environmental organizations, and other stakeholders interested in land use and development issues.

WHAT IS LID?

Low Impact Development (LID) is a method of developing land that works with the natural hydrology of a site to capture and disperse storm water as close to its source as possible. Rather than sending stormwater to a system of storm drain pipes, LID works to distribute stormwater across a project site. In addition to capturing and filtering pollutants from storm water runoff, LID techniques can decrease infrastructure expendituresand maintenance costs, and enhance the marketability of projects.

On a broad scale, LID can maintain and restore a watershed's hydrologic and ecological functions while also improving water quality. Some methods of implementing LID are:

- Conserving natural landscape elements
- Minimizing impervious cover
- Employing bioretention facilities

These techniques are not bound to only environmentally-sensitive areas but can be implemented everywhere. LID is suited for new development, redevelopment, and retrofit projects, and can be adapted to a diversity of land uses and geographic settings.

LID TOOL BOX

RAINWATER HARVESTING

INSTALLATION COST: **$$$$**

Rainwater harvesting is an alternative approach to capturing, storing, and reusing roof runoff. Rainwater harvesting systems are best used in highly urbanized areas, where impervious surfaces are unavoidable and site constraints limit the use of other LID practices. Rainwater harvesting systems range in size and complexity and include cisterns ($$$$), rain barrels ($$), and underground storage ($$$$). Rainwater harvesting systems can also reduce demand on municipal water resources. Harvested rain water can be used for irrigation and agricultural purposes.

STORMWATER WETLANDS

INSTALLATION COST: **$$$**

Stormwater wetlands are designed to remove stormwater pollutants and store runoff in relatively shallow pools that support conditions suitable for the growth of wetland plants. Additionally, they provide wildlife habitat and aesthetic features.

While stormwater wetlands have limited applicability in urbanized settings, they are a desired technique on larger sites, with relatively flat or gently sloping terrain. Most soil types can accommodate stormwater wetlands in the H-GAC region.

VEGETATED SWALE

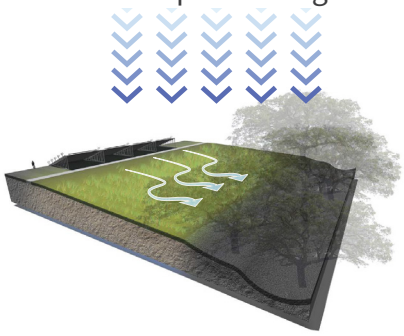
INSTALLATION COST: $$

A vegetated swale is a broad, shallow channel with a dense stand of vegetation covering its banks and bottom. Swales are designed to convey and treat stormwater, promoting infiltration, removing particulate pollutants, and reducing the flow velocity of stormwater runoff. Vegetated swales can be used on sites that naturally support a dense vegetative cover and on sites that have an appropriate area and slope. Swales are most effective when used in conjunction with other LID techniques. They are widely used to convey and treat stormwater runoff from parking lots, roadways, and buildings and are compatible with most land uses.

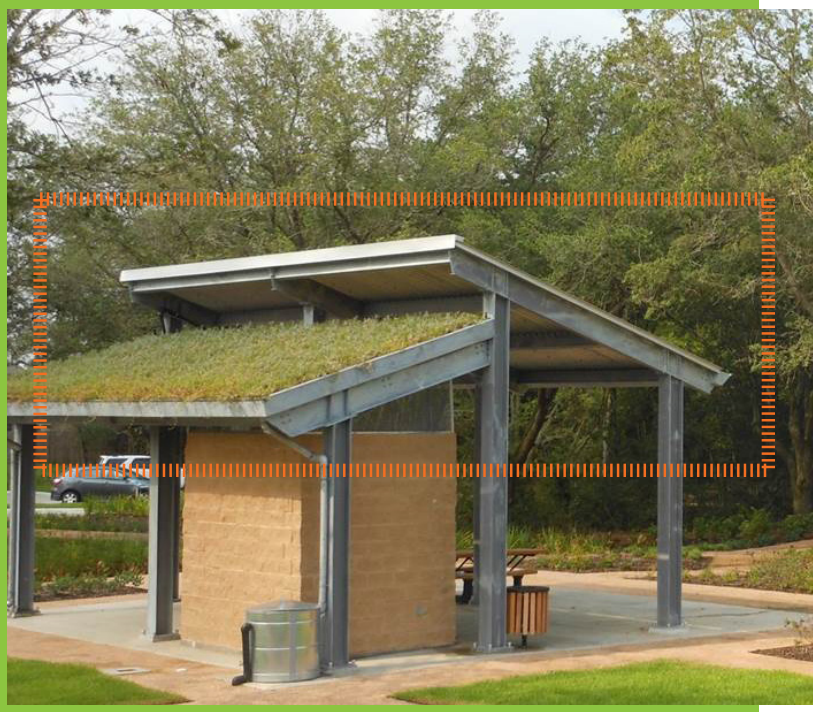
VEGETATED FILTER STRIP

INSTALLATION COST: $

A vegetated filter strip is a dense band of vegetation (usually a mix of grasses or other native plants) that is designed to slow runoff from adjacent surfaces, filter sediment and pollutants, and provide some infiltration. Filter strips are best suited on sites that naturally support dense vegetation and require a large surface area relative to other LID techniques. Filter strips are best used in treating runoff from roads, roofs, small parking lots, and other small surfaces. The primary difference between a vegetated filter strip and a vegetated swale is that swales accept concentrated flow while filter strips accept flow as distributed (sheet flow).

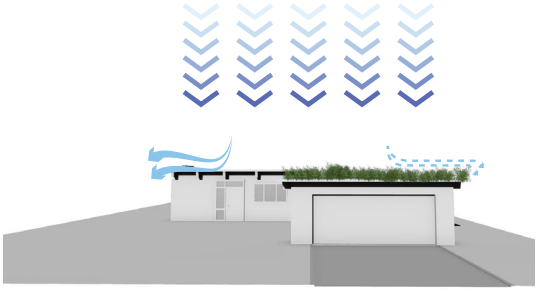


GREEN ROOF



INSTALLATION COST: **$$$$$**

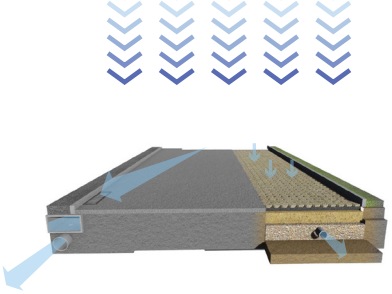
A green roof is a vegetative layer grown on a rooftop that filters, absorbs, and/or detains rainfall. The green roof system typically contains a lightweight soil media underlain by a drainage layer and a layer of impermeable membrane designed to protect the building structure. Water is captured and detained in the soil and dispersed through evaporation or transpiration by the plants. Green roofs reduce volume and peak rates of storm water and enhance water quality through various physical, biological and chemical processes in the soil. Other benefits include reduction in heat island effect and building heating/ cooling costs.



PERMEABLE PAVEMENT

INSTALLATION COST: **$$$**

Permeable pavement is designed to allow water to pass through the surface into the soil or underdrain/ subsurface detention or retention system. These systems treat stormwater that falls directly on the surface as well as runoff from adjacent impervious surfaces. Permeable pavement includes a wide range of paved or load-bearing surfaces that can be used as a substitute to conventional pavement on parking areas and low traffic roads (no truck traffic). This technique should only be used in areas that are flat or have gentle slopes with underlying soils that offer appropriate permeability rates.



BIORETENTION SYSTEMS:

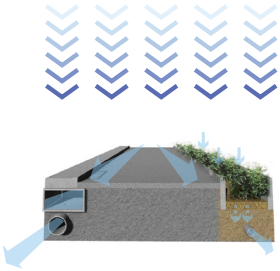
1) BIORETENTION CELLS

2) TREEBOX FILTER

A bioretention area is an upland soil and plant-based filtration mechanism designed to control and improve the quality of stormwater runoff. A properly designed bioretention area can infiltrate and temporarily store runoff, reducing a site's overall runoff volume and helping preserve predevelopment peak discharge rate and timing. Bioretention areas are proven to reduce pollutant loads. There are two main types of bioretention systems: bioretention cells and tree box filter.

BIORETENTION CELL

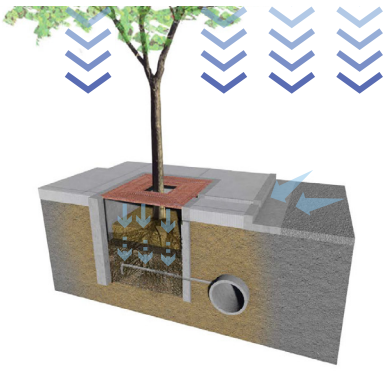
Bioretention cells or rain gardens or stormwater planter boxes are vegetated depressions layered with engineered soils that filter pollutants, increase time of concentration, and prevent surface ponding of stormwater. These systems may or may not have an underdrain based on site and design considerations. Although they are applicable in most settings, rain gardens are best used on small sites and/or in urbanized and suburban areas.



INSTALLATION COST: **$$$**

TREE BOX FILTER

A tree box filter is a bioretention system enclosed in concrete or other sub-surface type of container that is installed beneath trees. The sub-surface container contains trees that are supported by engineered soils. Runoff is directed to the tree box, where water is filtered by vegetation before entering a catch basin. The stormwater also serves to irrigate the tree and other vegetation in the tree box filter.



INSTALLATION COST: **$$$**

PUTTING IT TOGETHER:

TREATMENT TRAIN

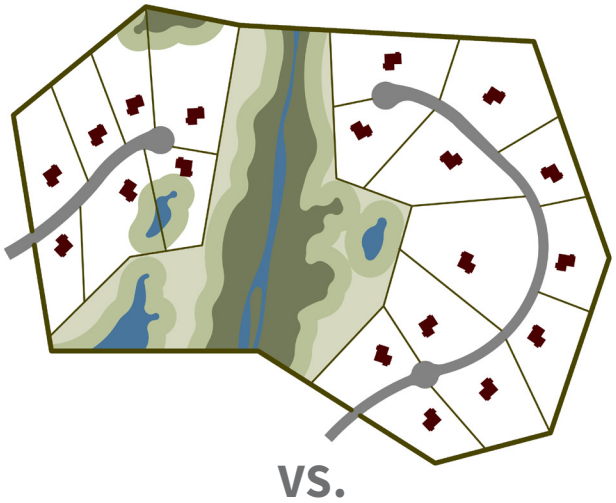
A treatment train consists of a series of stormwater practices designed to work in conjunction with one another to maximize the effects of LID. This method is desirable for many reasons. First, implementing a number of LID practices optimizes pollutant removal by allowing a variety of unit processes (sedimentation, filtration, biological uptake, etc.) to treat storm water runoff. Second, using multiple LID systems provides a level of redundancy so that at least partial treatment is being achieved even if one system is not functioning properly. The treatment train's greatest potential benefit is the reduction in maintenance costs.

The configuration for a treatment train can take many different forms. For example, the use of a vegetated swale to convey stormwater to or from other treatment systems, such as bioretention cells.

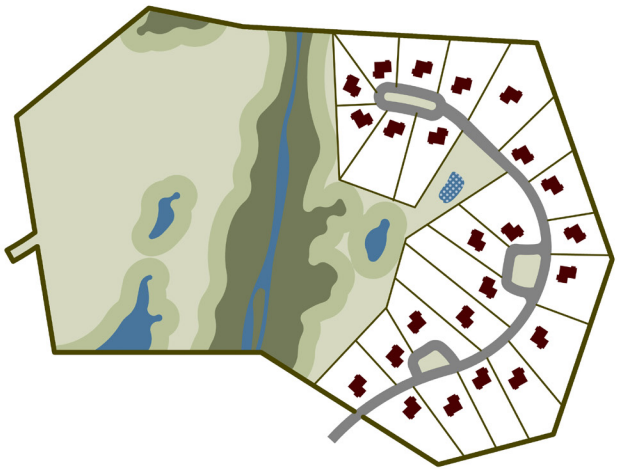
PUTTING IT TOGETHER:

SUSTAINABLE SITE DESIGN

CONVENTIONAL SITE DESIGN



VS.



SUSTAINABLE SITE DESIGN

Sustainable site design incorporates design approaches to development projects which reduce the environmental "footprint" of the site. Many of the sustainable site design concepts employ non-structural, on-site treatment that can reduce the cost of infrastructure while maintaining, or even increasing, the value of the property relative to conventional designed developments.

The goals of sustainable site design include:

- Minimize impervious surfaces;
- Manage stormwater (quantity and quality) as close to the source as possible
- Preserve natural areas
- Use natural drainage pathways as a framework for site design;
- Utilize simple, non-structural methods for stormwater management that are lower cost and lower maintenance than structural controls;
- Use appropriate plant species and communities for the eco-region and the designed media.

For more in-depth guidance on sustainable site design, please see the Sustainable Sites Initiative **www.sustainablesites.org**.

ABOUT DESIGN WORK SESSION

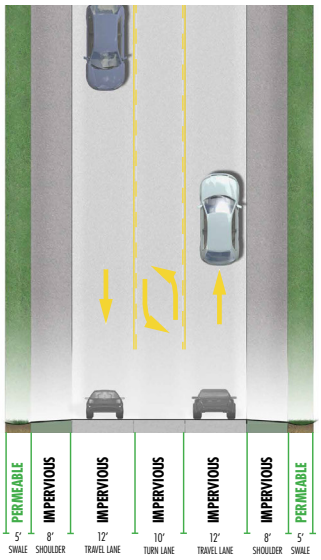
NARRATIVE:
Imagine you are reviewing site plans for City X, and you have been presented with this conventional site plan. City X is encouraging the use of LID on all site plans. You have been tasked with improving this plan with LID elements from the LID handbook.

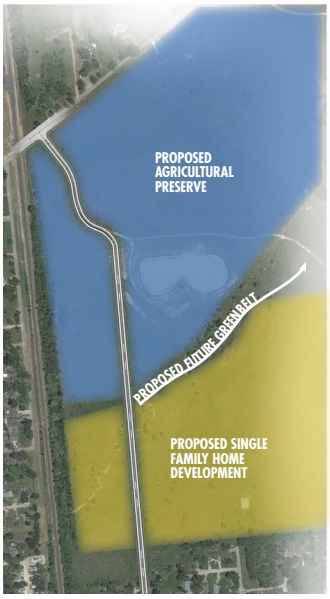
PROJECT ASSUMPTION:
There are no barriers to LID implementation in City X.

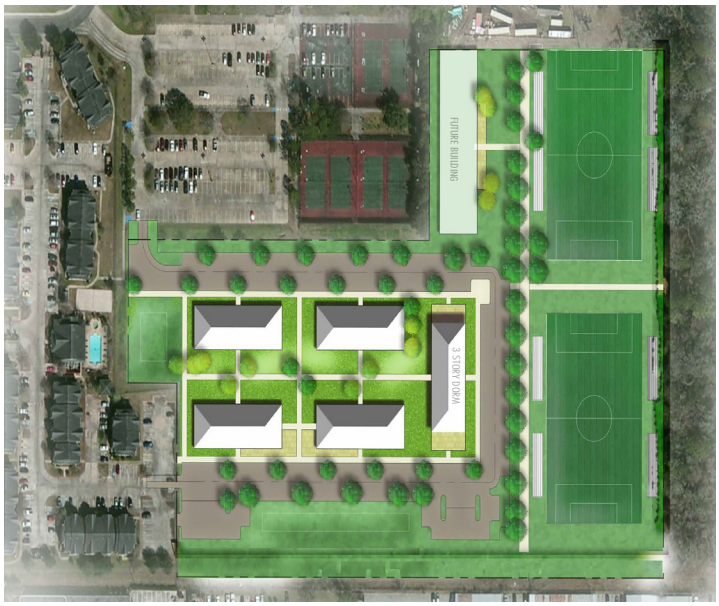
GENERAL DEVELOPMENT ASSUMPTIONS:

- 15% of Site Set Aside for Detention
- 100 Year Design Storm Event
- 200 SF/ Parking Space
- 2' Contour Lines

LID DESIGN GOALS

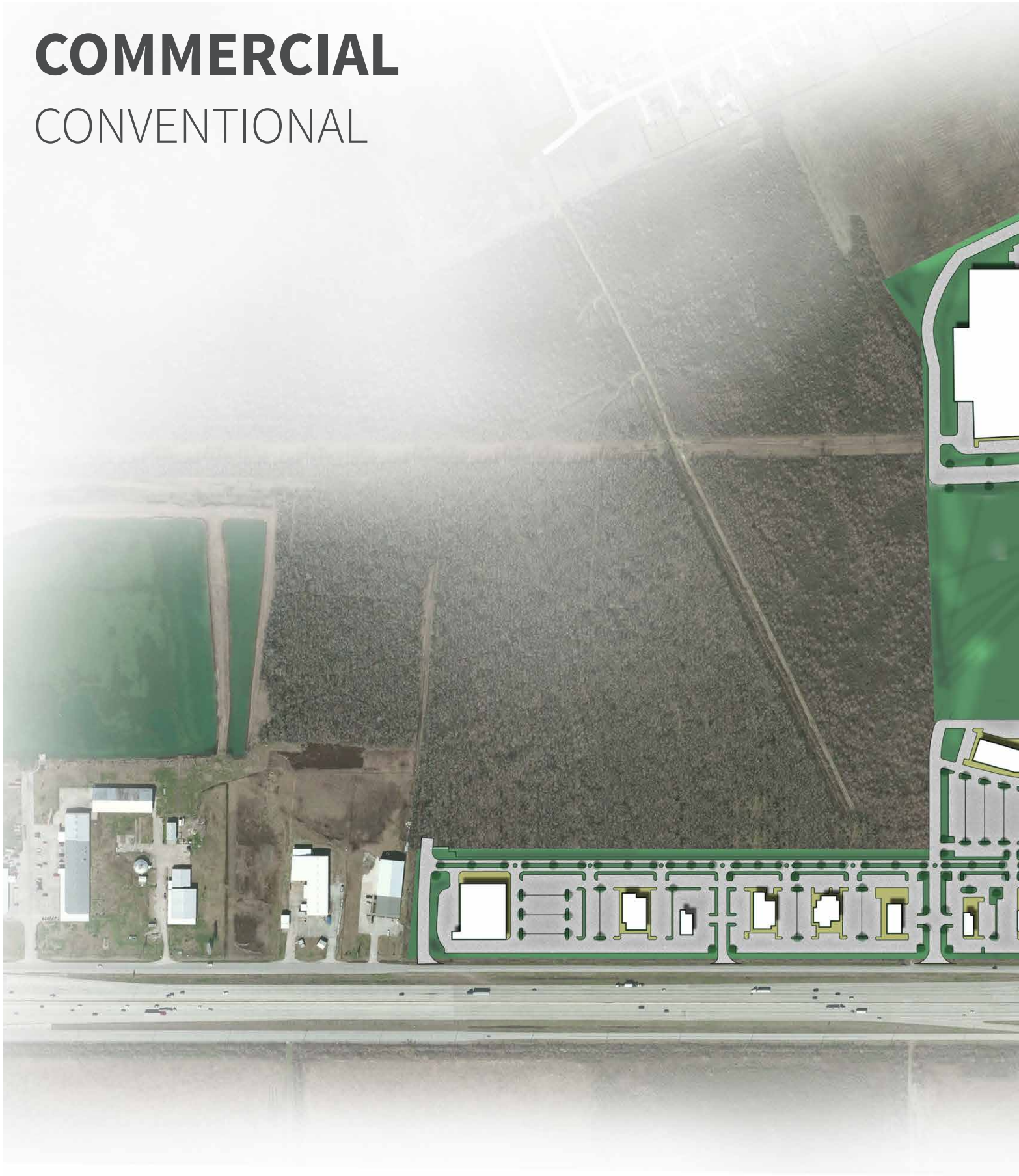






- Reduce development and infrastructure costs
- Reduce detention requirements
- Reduce runoff from a site by managing stormwater as close to its source as possible
- Improve stormwater quality
- Add value to development projects through LID amenities

COMMERCIAL
CONVENTIONAL



SITE REPORT

This commercial site is on the edge of a major highway just outside a suburban town experiencing rapid growth due to its proximity to Houston. The site is a 79.6 acre development, nearly flat, with a dense bottomland hardwood tree canopy cut through by an east west roadway easement and a north south pipeline easement. Soils in this area are dense clay and do not drain well. Just east of the site lies a 100 year floodplain which drains to adjacent waterways and a future planned open space and park amenity. Due to the relatively flat nature of this site, the current hydrology is composed of small pools forming at the center of the site, flowing away from the raised highway and roadway embankments surrounding the property.

The site is slated to be developed as a commercial center, requiring a minimum of one parking space for every 200 square feet (SF) of building area. Parking area and space circulation area requirement is 350SF. Building heights in this area are not restricted, but expected to maintain a one to two story height average.

DEVELOPMENT SUMMARY

- 79.6 ACRE DEVELOPMENT
- 396,400 SF OF LEASABLE FLOOR SPACE
- 2,086 PARKING SPACES REQUIRED
- 11.6 ACRES OF DETENTION
- SINGLE STORY BUILDINGS THROUGHOUT

MULTI-FAMILY
CONVENTIONAL

SITE REPORT

This 22 acre site is located on a large, undeveloped property adjacent to a shopping center and a major highway. The large amount of development in this region has caused some flooding concerns already, and the existing topography of the site has very well defined ridges and valleys, funneling water through two major drainages to the eastern corner of the site. The site is currently covered by well developed tree canopy. It is located completely outside of the 100 year flood plain. The soils are dense clay soils that do not drain well.

The site is to be developed as a large, phased multi-family development to house upwards of 400 units. Parking requirements are two parking spaces for each unit. The maximum height for apartment developments in this area is four stories.

DEVELOPMENT SUMMARY

- 21.8 ACRE DEVELOPMENT
- 416 UNITS (AVG UNIT = 800 SF)
- 833 PARKING SPACES REQUIRED (2/UNIT)
- 1,002 PARKING SPACES SUPPLIED
- 0.333 ACRES OF AMENITY AREAS
- 3.25 ACRES OF DETENTION
- 2 STORY BUILDINGS THROUGHOUT

SINGLE FAMILY
CONVENTIONAL

SITE REPORT

This 28-acre site is located just on the outskirts of existing suburban development patterns. A near perfectly flat and undeveloped greenfield, the site is notable for excellent tree canopy cover and is located between large single family home development and a busy farm to market road.

Waterways exist to the north and south of the site, but none cross through the site itself. Water generally pools inward on site, away from road and home embankments. Soils here are somewhat sandy and do drain well, making them suitable for deep infiltration.

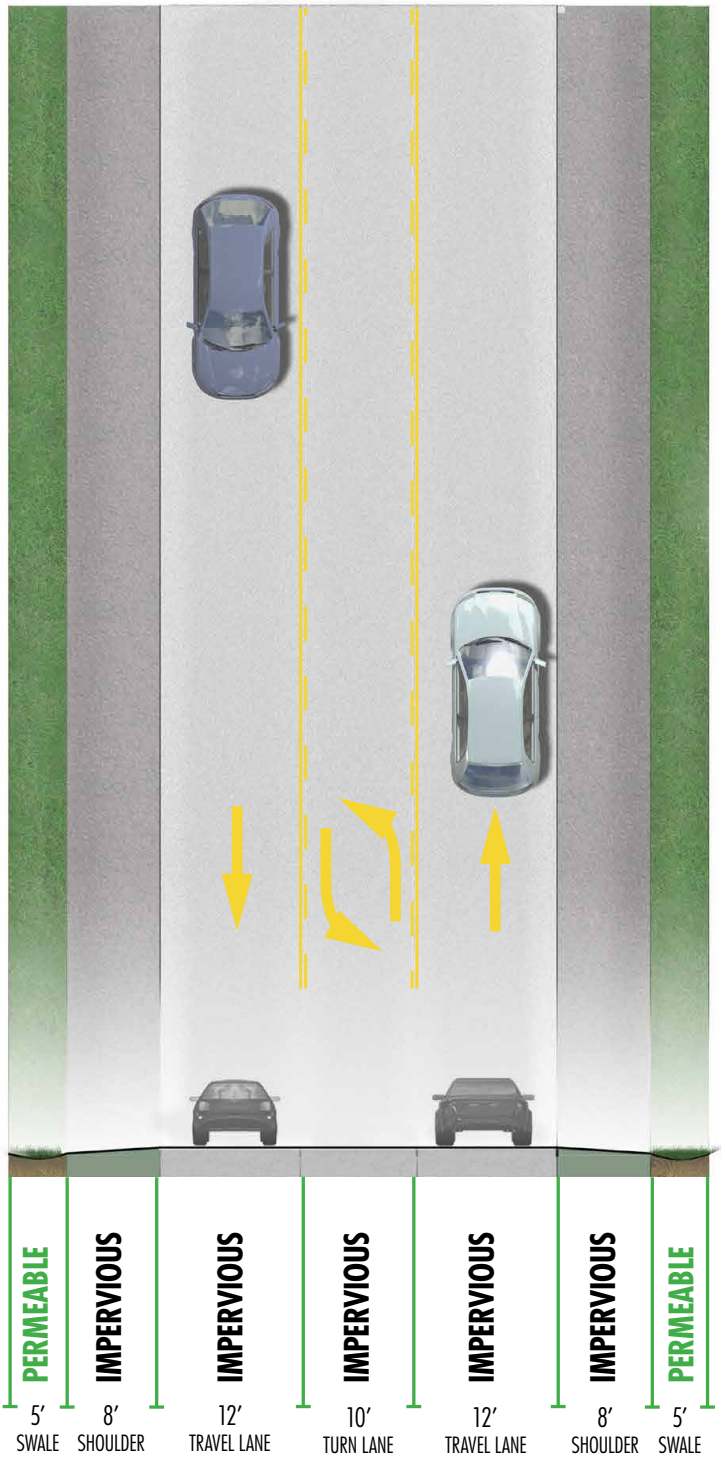
The site is zoned for single family development and will likely be built by a single developer/builder combination. The city requires development to not exceed cul-de-sacs of greater than 400' and also to provide sidewalks throughout the development.

DEVELOPMENT SUMMARY

- 23.7 ACRE DEVELOPMENT
- 89 UNITS
- 2 CAR GARAGE & ON-STREET PARKING
- AVERAGE 40' SETBACKS
- 30' ROADWAY PROFILES
- 3.8 ACRES OF DETENTION
- 5' SIDEWALK ON BOTH SIDES OF STREET
- 140,400 SF OF ROADWAY AREA

ROADWAY

CONVENTIONAL



ROAD SECTION - TYPICAL

SITE REPORT

This .5 mile planned roadway is a rural extension which crosses a creek bed to provide transportation connections to a growing residential population to the south.

The hills of this region form a local watershed which generally drains to the creek crossing the site, which is planned as a future greenbelt and recreational amenity. The soils of this region are more permeable than many areas of the H-GAC region and could likely infiltrate better than those of coastal areas. There is little tree canopy on site as much of the area was previously agricultural. The northern extent of the road utilizes an old roadway base and will be constructed as a retrofit, rather than a full reconstruction.

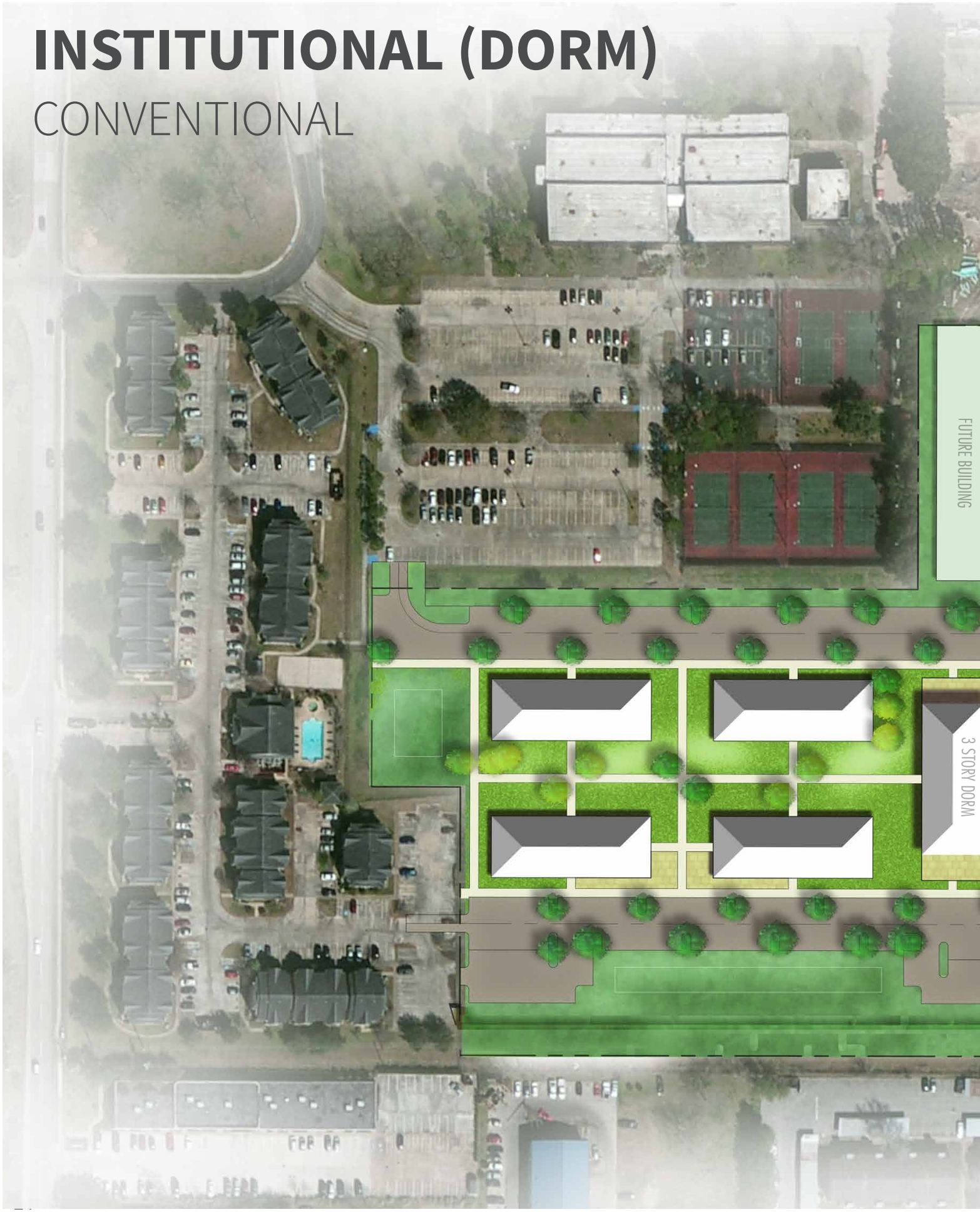
The roadway is planned with 60' right of way (ROW) width to carry a moderate amount of traffic between single family homes and the farm to market road to the north.

DEVELOPMENT SUMMARY

- 0.5 MILES IN LENGTH
- 35 MPH CONNECTOR ROADWAY BETWEEN FARM TO MARKET ROAD AND EXPANDING SINGLE FAMILY HOME DEVELOPMENT
- 60' ROW
- 16% PERMEABLE SURFACES, 84% IMPERVIOUS SURFACE (%OF TOTAL ROW)

INSTITUTIONAL (DORM)

CONVENTIONAL



SITE REPORT

This 15 acre site is located at a university campus in a suburban county. The expansion and growth of the student body requires the development of a new dorm facility along with expanded recreational fields. The site planned for development is hemmed in by existing university recreational facilities, dorms, and adjacent multi-family housing. To the east of the site is a large drainage basin and floodplain which drains directly into the bayou and the Gulf of Mexico. As wetland, this area's waterways provide critical stopping grounds for migratory birds. The soils on this site drain very poorly.

As owner of the land and property, the university has a great deal of flexibility regarding how to develop the property but are seeking to provide a minimum of 250 new dorms and parking for 1.5 cars per dormitory.

DEVELOPMENT SUMMARY

- 15.8 ACRE SITE
- 196 STUDENT DORM UNITS (AVG 600 SF DORM)
- 294 PARKING SPACES REQUIRED (1.5 CARS/ DORM)
- 344 PARKING SPACES SUPPLIED
- 2.25 ACRES OF DETENTION
- TWO FULL SIZE SOCCER FIELDS

NOTES:

NOTES:

The Houston-Galveston Area Council has been awarded a grant from the U.S. Environmental Protection Agency – Gulf of Mexico Program to address water quality, coastal ecosystems improvement, community resilience, and environmental education in the Gulf of Mexico region and its watersheds.

DESIGNWORKSHOP

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

GULF OF MEXICO PROGRAM

Houston-Galveston Area Council

LAND / WATER SUSTAINABILITY FORUM HOUSTON