2.1 Principles & Objectives

Land planning which integrates the natural features of a site (i.e., *“designing with the landform”*) into the site design is a major component of the Green Growth Guidelines. Site plans that accomplish this integration create livable places where natural resource conservation and wildlife management are the cornerstones for success.

On a regional scale, green growth strategies include the formation of compact nodes of developments connected by transportation routes and large, contiguous, green space corridors. On an individual site level, vital ecological areas are linked to the community for an improved connection to nature and to create a unique and distinctive sense of place. By understanding the context of an individual site, a site plan can be designed within the constraints of the landform, while utilizing the natural features for environmental and economic benefits. Thus, the two guiding principles which direct “*designing with the landform”* are (1) to sustain the integrity of the surrounding natural resources and (2) to preserve and maintain cultural and natural features. These principles are exemplified in the following basic green growth practices:

- Minimize land disturbance and erosion by working with the natural topography and hydrology of the site,
- Locate development away from critical environmental areas such as wetlands, cultural resources, and wildlife corridors,
- Maintain continuous buffers and conservation areas, especially along streams and water bodies (Avoid fragmentation of buffers by roads, utilities, and trails, to the greatest extent possible),
- Retain a large area of green space that is either preserved in a natural state or open to the public for recreation,
- Decrease the size of residential lots, streets, driveways, parking areas, and rights of way so as to increase green space acreage,
- Design compact development footprints that minimize impervious surface area and reduce stormwater runoff,
- Preserve the natural hydrology of the site and/or design stormwater facilities that retain runoff on-site,

- Preserve existing trees and vegetation and incorporate into the development, especially old growth areas and monumental specimens,
- Use native or locally adapted drought or salt tolerant species, and
- Locate roads, buildings, and septic systems in areas of suitable soil (avoiding poorly drained or "hydric" soils).

While these principles are already in use in many parts of the United States, the focus of this chapter is to adapt these principles in the coastal Georgia area. Benefits from this approach include (CWP, 1988, pp5):

- Protection of wetlands, sensitive forests, and habitats,
- Reduction of stormwater loads,
- Reduced soil erosion during construction,
- Reduced construction costs,
- Increases in property values and tax revenue,
- Safer residential streets,
- Improved locations for stormwater facilities,
- Easier regulatory compliance,
- Creation of a sense of community within the development, and
- More aesthetically pleasing development.

When green growth principles and practices are applied in the four primary planning areas (namely Conservation, Streets and Parking, Lot Development, and Stormwater Management) the benefits noted above can be realized. These principles form the basis for a better site design where (1) impervious cover is reduced, (2) natural areas are conserved, and (3) stormwater pollution is decreased as much as possible.

The first sections of this chapter detail the recommended practices for implementing design principles in each of the four primary site planning areas. The four main steps in the design process are:

- Identification of buildable and conservation areas (Conservation Design),
- Layout of the proposed streets and parking systems (Streets and Parking Practices),
- Layout and configuration of the building lots (Lot Development), and
- Layout of stormwater facilities (Stormwater Management).

A comparison of the environmental, economic, and social benefits of these green growth principles in practice on the Tupelo Tract concludes the chapter.

The following principles and practices in this chapter were largely derived from *Better Site Design: A Handbook for Changing Development Rules in Your Community*, Center for Watershed Protection, August 1988.

2.2 Conservation Design

Green growth strategies seek to preserve the natural and cultural features of a site. This approach utilizes the existing natural features within conserved areas to facilitate this effort, including the removal of stormwater pollutants. This is achieved by designing and building more compact developments on one portion of a site (the "buildable" area) while preserving significant greenspace on another portion (the "primary" and "secondary" conservation areas). The preservation of greenspace can result in significant economic, environmental, and social benefits, as shown throughout these Guidelines.

The first step in the design process is to identify areas within the site that should be permanently protected (i.e., "non-buildable" areas). This usually begins with the analysis of a composite resource map, compiled using GIS or by other conventional means. (Figure 2.2.a) This multi-layered map provides a distinction between primary and secondary conservation areas.

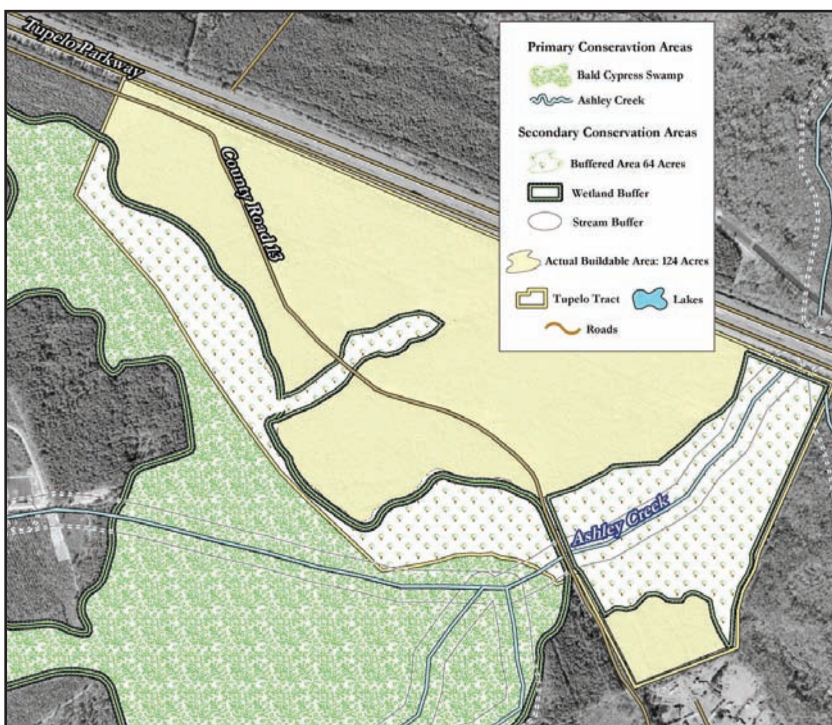


Figure 2.2a Composite Resource Map Using GIS

Image Created by: Patrice Cook

Primary conservation areas are non-buildable areas composed of:

- Wetlands (Freshwater and Tidal),
- Floodplains,
- Streams and Essential Buffers,
- Endangered Species and Critical Habitat, and
- Significant Historic or Archeological Sites.

Secondary conservation areas may be considered "buildable" but have significant value if left undisturbed. These features include:

- Mature Woodlands,
- Enhanced Buffers Along Streams and Wetlands,
- Greenways and Trails,
- Sites of Interest, and
- Scenic Vistas.

The following practices used during this first step in the design process are applicable to ensuring preservation of the natural features of the site with the added benefit of improved water quality.

2.2.1 Reduce Impervious Cover and Land Disturbance

There are strong arguments for designing more compact communities that minimize land disturbance and conserve natural areas. The first being that the environmental health of a watershed is diminished with development activities that increase land disturbance and impervious cover. Construction activities expose sediments and construction materials to rainfall, which washes material into storm drains or directly into nearby waterways. After construction, meadows, forested areas, and other natural landscape features are replaced with compacted and fertilized lawns, impervious pavement, and rooftops. These largely impervious surfaces generate substantial quantities of surface runoff. (Figure 2.2.1.a)

Figure 2.2.1a Aerial View of Extensive Impervious Cover

Image Created By: Patrice Cook

Engineers traditionally design drainage systems to move rainwater as quickly as possible by directing it towards curbs, gutters, streets, and sewers. These conventional drainage systems prevent water from flowing into the ground and filtering through soil before being released into surface and ground waters. To compound problems, traditional construction practices seek to 'connect' all of the impervious surfaces in a development to direct water to a minimal number of drainage outlets. Even when landscaping is built into the project, the grading typically directs water away from the landscaping, thus losing any opportunity to 'disconnect' the imperviousness for infiltration. This connected system instead creates more surface runoff—and this results in increased flooding, erosion, pollution, and degraded streams. (James Woodworth, 2002.) (Figure 2.2.1.b)

Figure 2.2.1b Degraded Stream Buffer Cleared for Residential Construction

Photo Courtesy of: Matt Renault

It is important to note that much of the *pervious* surfaces left on low-density development, including lawns and other maintained areas, act like impervious surfaces for water quality purposes. However, disturbed and impervious areas vary widely in the amount, speed, and type of runoff per square foot. At one time, lawns were thought to provide "open space" for infiltration of water. However, development can involve wholesale grading of the site, removal of topsoil, severe erosion during construction, compaction by heavy equipment and filling of depressions. Research now shows that the run-off from highly compacted lawns is almost as high as paved surfaces. (Thomas Schueler, 2000.)

Conservation design reduces stormwater runoff by creating compact communities that minimize land disturbance and impervious surfaces, and conserves natural areas by using smaller lots that are spaced closer together. This design practice accomplishes three major water quality goals: (Figure 2.2.1.c)

Figure 2.2.1c Aerial View of Compact Development

Compact Developments Reduces Land Disturbance

Image Created By: Patrice Cook

- Reduced impervious cover,
- Reduced land disturbance due to smaller development footprint, and
- More green space available to serve critical ecological functions (generally 20-50% of the total site area conserved).

Conservation designs also typically result in a reduction in supporting infrastructure because the design is more compact. In fact, compact developments can reduce the capital cost of subdivision development by 10% to 33%, primarily by reducing the length of the infrastructure (roads and pipes) needed to serve the development. Additionally, the need to clear and grade is reduced by 35% to 60%. Since the total cost to clear, grade, and install erosion control practices can range up to $5,000 per acre, reduced clearing and earthworks can be a significant cost savings to developers. (Schueler, 2000 and NAHB, 1986.)

2.2.2 Preserve Native Vegetation & Soils

2.2.2.1 Native Trees & Vegetation

A key principle of designing with the landform is retaining or adding significant areas of native vegetation to provide a forested canopy. Trees are the most valuable resource found on a project site. Trees and native vegetation uptake excess rain water and need little or no irrigation because they are acclimated to this region's climate and rainfall. Trees can also increase the value of individual lots by providing aesthetics and moderating temperatures, but they can also act as wind buffers and are one of the most effective filters for stormwater.

The forest canopy can significantly reduce the volume of stormwater runoff. A modeling study by Henson and Rowntree (1988) reported that due to forest cover, stormwater decreased by 17% during a typical one-inch rainstorm. This effectiveness is achieved by a greater surface area on the leaves, twigs, branches, trunks, leaf litter and soil with which the water can interact. The whole system acts as a sponge, absorbing, treating and retaining stormwater in vast quantities. (Figure 2.2.2.1.a-b)

Figure 2.2.2.1a Vegetation Along Stream Bank
Photo Courtesy of: Tara Merrill

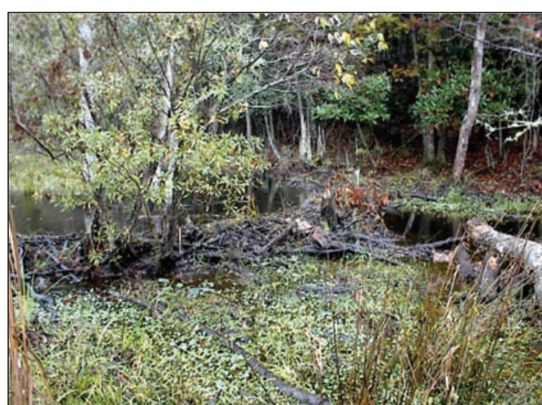


Figure 2.2.2.1b Native Wetland Vegetation
Photo Courtesy of: Tara Merrill

Two regional economic surveys document that conserving forests on residential and commercial sites can enhance property values by an average of 6% to 15% and influence the rate at which units are sold or leased (Morales, 1980; Weyerhaeuser, 1989). A study from Atlanta, Georgia, also showed that the presence of trees and natural areas measurably increased the residential property tax base (Anderson and Cordell, 1982). Measures to protect these important and valuable resources include:

- Locate trees before detailed planning and engineering,
- Establish tree save areas early in the planning process and protect them during construction,
- Keep large contiguous swathes of forested areas to maintain wildlife corridors and preserve native species, and
- Give special attention to vegetation along tidal and freshwater wetlands and streams to aid in filtering stormwater runoff before entry.

2.2.2.2 Analyze Soils

In addition to native vegetation, existing soils should be considered during the planning and design phases of development. The actual performance of soils is based in great part on local conditions including:

- Severity and duration of local rainfall,
- Soil compaction,
- Velocity of runoff,
- Site contours,
- Type and density of vegetation,
- Substrate type and properties,
- Distance to the water table, and
- Percolation and permeability parameters.

An analysis of all soil related information, including percolation and stability, is essential in determining the placement of streets, lots, buildings, septic drain fields, wells and other site amenities. By knowing the location of certain soil series, planners can design the development to avoid unsuitable areas, such as hydric soils found in wetlands and poorly drained areas. Basic design practices for soil include:

- Avoid soil compaction that increases runoff. Soil compaction restricts infiltration, deep rooting, and the amount of available water, thus, inhibits plant growth.
    - Measures that prevent compaction include diverting traffic from areas of moist or wet soils and increasing the content of organic matter,
- Avoid hydric (wetland) soils for roads and building foundations,
- Avoid placement of septic systems in areas of poor soil – this can cause system failure and the release of contaminated effluent to groundwater aquifers,
- Avoid locating buildings in low areas that require the addition of fill material, especially in floodplains and wetlands which can result in structural flooding and resource degradation,
- Avoid building development along unstable slopes susceptible to erosion,
- Retain native trees and vegetation which naturally confine soil in place, and
- Implement proper sediment and erosion control measures that contain soils on site during construction [Sediment barriers (silt fences, hay or straw bales) and sediment traps (forebays) are inexpensive and effective solutions. These practices are detailed in the *Manual for Erosion and Sediment Control in Georgial*, 5th Edition, Soil & Water Conservation Commission 2000]. (Figures 2.2.2.2.a and 2.2.2.2.b)

Figure 2.2.2.2a Failed Sediment Control Fence

Image Courtesy of: Chere Peterson

Figure 2.2.2.2b Effective Sediment Control Fence Preventing Sedimentation of Adjacent Wetland

Photo Courtesy of: Dan Fischer

2.2.3 Protect Wetlands and Streams

When impervious cover in upstream watersheds exceeds 10%, the quality of local streams, lakes, and wetlands declines sharply, and the following impacts often result (CWP, 1998):

- Higher peak discharge rates and greater flooding,
- Lower stream flow during dry weather (clearly evident in coastal Georgia during the recent drought),
- Greater stream bank erosion,
- Alteration of natural stream channels,
- Degradation of stream habitat structure,
- Increase of sediment disposition in nearby streams,
- Fragmentation of riparian forest corridor,
- Warmer stream temperatures,
- Greater loads of stormwater pollutants,
- Decline in wetland plant and animal diversity; lower diversity of aquatic insects and native fish species,
- Sewage derived bacterial levels that exceed recreational contact standards, and
- Increased number of stream crossings with greater potential to affect fish passage.

Not only is it critical for these resources to remain intact and functional for environmental reasons, it is also economically sensible to preserve these areas. Economists have calculated that each acre of coastal wetland contributes from $800 to $9,000 to the local economy through flood protection and recreation such as fishing, boating, and bird watching. (Kirby, 1993.)

2.2.3.1 Wetlands

Coastal wetland systems are some of the most productive ecosystems in the world. Georgia's tidal wetlands account for a third of all remaining saltwater wetlands on the east coast. Of equal importance, freshwater wetlands and streams provide essential habitat for a range of species, including some that depend on aquatic environments part or most of their life cycle. In addition, wetlands, both tidal and freshwater, provide surface and groundwater filtration and storage, flood protection, and erosion control. The water quality of these systems is essential to the overall quality of the watershed and its inhabitants. (Figure 2.2.3.1.a)

Figure 2.2.3.1a Emergent Wetlands Serve as Habitat to a Diverse Population of Birds, Animals, Fish, and Plants

Photo Courtesy of: Chere Peterson

Wetlands are crucial to overall water quality as they are labyrinths of vegetation, root structures, soils, surface and submerged landforms, chemical processes, and biological activities that filter sediments and toxic substances from stormwater before discharging it into rivers and oceans. For this reason, keeping these wetland systems intact and functional is a key element of designing a green or low impact development. (Figure 2.2.3.1.b)

Figure 2.2.3.1b Coastal Marshlands are some of the Most Productive Ecosystems, serving as Nurseries for Aquatic Wildlife

Photo Courtesy of: Tara Merrill

The following design practices for wetland protection should be followed:

- Avoid construction in wetlands or their buffers by building compact developments,
- Plan roads and utilities to cross at the narrowest point in the system,
- Design crossings perpendicular to the resource, diagonal crossings generally increase the area disturbed,

- Use permeable paving for access roads, trails, or overflow parking,
- Enhance water quality by using natural wetlands for stormwater control, which puts stormwater where nature intended it,
- Avoid construction in contiguous and isolated wetland systems (these areas can provide natural stormwater detention for a development),
- Preserve riparian buffers along wetlands and wildlife habitat, and
- Create or construct wetlands that mimic natural hydrological processes to control non-point source pollutants from stormwater (see Chapter 3 - Stormwater Wetlands for a detailed description of this practice).

2.2.3.2 Streams

The quality of a receiving waterbody can be classified by the amount of impervious cover in the watershed. (Figure 2.2.3.2.a) The amount of impervious cover is critical because it governs the amount of stormwater runoff and pollutants that flow into the stream in large quantities over short time periods. Without impervious cover, water soaks into the soil replenishing groundwater and reducing stream bank erosion among other benefits. (Figure 2.2.3.2.b)

The primary goal of conservation design is to maintain pre-development stream

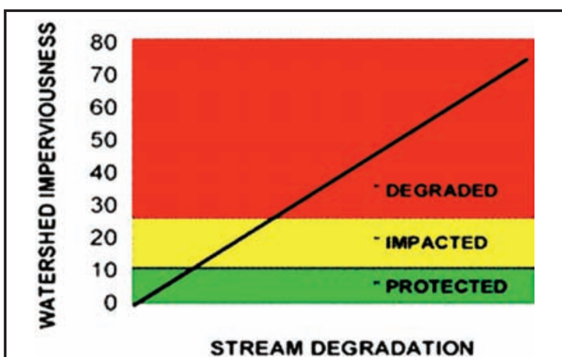


Figure 2.2.3.2a Relationship between imperviousness and receiving stream impact (adapted from Schueler, 1992).

Figure 2.2.3.2b Aerial View of Estuary with Tidal Flat

Photo Courtesy of: University of Oregon quality. Healthy streams are expected to have stable channels, relatively good water quality and a diverse population of aquatic insects and fish. Stream protection strategies include:

- Reduction in the width and length of crossings to a minimum,
- Use existing crossings when possible,
- Design bridges to span the farthest distance across streams,
- Use bottomless culverts beneath road crossings allowing for fish passage,
- Preservation of riparian buffers greater than 25' in width to improve water quality and provide sufficient habitat,
- Use of low impact stormwater practices that control pollutants at their source before reaching the stream (Chapter 3),
- Use of natural, non-invasive bank stabilization practices (Chapter 4), and
- Avoid alteration or obstruction to natural stream flow.

2.2.4 Protect Wildlife Habitat & Buffers

Vegetated riparian buffers and forested areas have the capacity to reduce stormwater volumes, remove pollutants, and slow erosive flows. Taking into account their varied and considerable impact on water quality, wildlife and more, forested buffer zones are investments yielding some of the highest returns to landowners and the public in the improvement of the quality of water and life. (Figure 2.2.4.a)

Figure 2.2.4a Vegetated Riparian Buffer on Satilla River

Photo Courtesy of: UGA Marine Extension Service, Brunswick

If a wetland is nature's water filter, the riparian buffer is the pre-filter. The vegetation and soils in the buffer area perform a number of important tasks in pretreatment of stormwater runoff before it reaches the stream. It is important that runoff flow enter the buffer zone as a sheet of water rather than concentrated flow. Techniques such as bioretention areas and grassed filter strips disperse the flow as much as possible prior to entry into a buffer zone. This process slows the water and allows the vegetation to remove harmful non-point source pollutants. Some of the important effects buffer zones can have on protection of water quality include:

- Infiltration of water into the buffer zone soil as vegetation slows flow velocity (While simple friction with the surface slows flow, vegetation and the resulting accumulation of organic litter is much more effective),
- Groundwater, a major component of stream flow, filters itself if it enters the stream via a path that passes through the soil and roots of the buffers zone, greatly expanding the effectiveness of the zone's impact on water quality,
- Nitrogen and phosphorus can be effectively removed from water flow by biochemical processes in the buffer zone (Vegetation facilitates these processes),
- Buffer zone vegetation traps sediments (The same process that slows flow velocity through the buffer also breaks up sediments into particulates that settle to the buffer floor and become part of the soil. Thus, the sediment never reaches the stream and any phosphorus becomes a nutrient for buffer zone vegetation),
- Soil in the buffer zone makes water entering the stream less acidic (The pH of water in the zone is raised by side effects of denitrification and other beneficial processes. The acidity of flow into the stream is important because water that is too acid can have toxic effects on marine life),
- Herbicides and pesticides have also been removed by biochemical activity in the buffer zones (Thus far limited research has shown atrazine, alachlor, trifluralin, and 2,4-D can be removed by buffer zones), and
- The area surrounding a stream is cooled not only by shading but by a micro-cooling process called evapotranspiration (Forested buffers are most effective in both types of cooling). (Figure 2.2.4.b)

Figure 2.2.4b Healthy Stream with Adjacent Palustrine Wetlands

Photo Courtesy of: Tara Merrill

Streams, wetlands and areas where water is stored or treated even intermittently should be protected by a buffer of mixed (both woody and herbaceous) plants native to the region and suitable for local climatic conditions.

Size is an important factor in the effectiveness of buffer zones. The larger the space available for pretreatment processes such as filtration and chemical activity, the more such activity can take place. In addition, wildlife can utilize the area as habitat. The following chart shows pollutant removal effectiveness and wildlife habitat value as a function of increased buffer width; generally the wider the buffer-the more effective:

Buffer Width (m)	Pollutant Removal Effectiveness	Wildlife Habitat Value
5	Approximately 50% or greater sediment and pollutant removal	Poor habitat value: useful for temporary activities of wildlife
10	Approximately 60% or greater sediment and pollutant removal	Minimally protects stream habitat;poor habitat value: useful for temporary activities of wildlife
15	Greater than 60% sediment and pollutant removal	Minimai general wildlife and avian habitat value
20	Approximately 70% or greater sediment and pollutant removal	Minimal wildlife habitat value; some value as avian habitat
30	Approximately 70% or greater sediment and pollutant removal	May have use as a wildlife travel corridor as well as general avian habitat
50	Approximately 75% or greater sediment and pollutant removal	Minimal general wildlife habitat value
75	Approximately 80% sediment and pollutant removal	Fair-to-good general wildlife and avian habitat value
100	Approximately 80% sediment and pollutant removal	Good general wildlife habitat value; may protect significant wildlife habitat
200	Approximately 90% sediment and pollutant removal	Excellent general wildlife value; likely to support a diverse community
600	Approximately 99% sediment and pollutant removal	Excellent general wildlife value; supports a diverse community; protection of significant species

Table 2.1: Vegetated Buffers in the Coastal Zone, A Summary Review and Bibliography (Desbonnet et. al.)

Contiguous buffers are more suitable as a wildlife habitat than smaller, isolated vegetated areas scattered across the development site. A continuous buffer provides a wildlife corridor that is of particular value in protecting amphibians and waterfowl populations, as well as coastal fish spawning and nursery areas. Such protection has an economic payoff as well, as research shows that nearly 60% of suburban residents actively engage in wildlife watching near their homes, and a majority is willing to pay a premium for homes located in a setting that attracts wildlife. (Adams, 1994.) (Figures 2.2.4.c-e)

Figure 2.2.4c-e Coastal Creatures (c) Blue Heron (d) Snowy Egret (e) Raccoon
Photos Courtesy of: Tara Merrill

Landscaped buffer zones planted with native trees and shrubs also filter stormwater and benefit avian, terrestrial, and aquatic species dependent upon riparian habitat for survival. Rapid maturity of these buffer zones to their natural state is part of the process of increasing the effectiveness of the entire system.

2.2.5 Increase Buffer Effectiveness

Buffers are created by designating a vegetated corridor along a stream or wetland as an undeveloped area. Careful site design and smart planning can increase the width of these areas by using a technique known as “stacking” the buffer. Essentially, an area adjacent to the standard “required” (usually 25’ from the stream) buffer area is used for a mixture of stormwater treatment practices. As an example, placing a bioretention area or filter strip outside of the state mandated 25’ buffer could essentially increase the area preserved along streams or wetlands. Since the bioretention area itself is vegetated, a buffer zone that could well exceed 100 feet in width may be created along the stream. This is substantially more effective than a more random location of these treatment practices. Since these areas are heavily wooded, buffers may be selectively pruned so that a resident’s view corridor to streams or wetland areas is not restricted. Recommended design practices include:

- Stacking treatment features to create a utilitarian, low maintenance zone of native forest (The more this area is left undisturbed, the more effective it will be),

- Avoiding placement of infrastructure in buffer zones (Roads and utility services can be "bundled" and run through the buffer zone together),
- Crossing buffer zones and their associated streams or wetlands at the narrowest possible point to limit disturbance,
- Avoiding multiple crossings and minimizing the width of crossings typically results in less environmental impact and a cost savings, and
- Using native vegetated buffers that do not require irrigation.

2.2.6 Preserve Greenspace

Community green space offers a number of benefits including: (Figures 2.2.6.a-b)

Figure 2.2.6a Community Greenspace

Photo Courtesy of: Matthew R. Baker

Figure 2.2.6b Conservation Easement in Midway, GA

Photo Courtesy of: Jill Huntington

- Reduced cost from using undevelopable land for runoff control and treatment,
- Reduced cost by eliminating the necessity for landscape maintenance for a fairly large portion of the property [Land owners can save between $270 to $640 per acre in annual mowing and maintenance costs when open lands are managed as a natural buffer area rather than turf (Wildlife Habitat Enhancement Council, 1992)],
- Better pedestrian movement, a stronger sense of community space and a park-like setting [Numerous studies have confirmed that developments situated near trails

or parks sell for a higher price than more distant homes. (North Inlet-Winyah Bay NERR Coastal Training Program, 2002)].

- Enhanced development by creating a centralized and often even educational natural area for the community,
- Preserved wildlife habitat for native species and nature-watching opportunities
- Improved marketability by meeting consumer demand for green space amenities; the quality of streams and wetlands can be linked to improved marketability of these areas [Communities have repeatedly found that property adjacent to protected wetlands, floodplains, shorelines, and forests constitutes an excellent location for development. (U.S. EPA, 1995). A sense of place is instilled by the presence of water, forest and natural areas and this preference is expressed in a greater willingness to pay to live near these habitats], and
- When managed as a "greenway," stream buffers can expand recreational opportunities and increase the value of adjacent parcels (Flink and Searns, 1993). [Several studies have shown that greenway parks increase the value of homes adjacent to them. Pennypack Park in Philadelphia is credited with a 33% increase to the value of nearby property – a net increase of more than $3.3 million in real estate value is attributed to the park. A greenway in Boulder, Colorado, was found to have increased aggregate property values by $5.4 million, resulting in $500,000 of additional tax revenue per year. (Chesapeake Bay Foundation, 1996.)]

2.3 Street & Parking Design

The second step is the design of an appropriate transportation network. Given recognition of natural features and planning to accentuate and preserve these features, the appropriate street pattern will accommodate the natural contours of the site while improving interconnectivity and safety. Since streets and parking areas are impervious collectors of grease, antifreeze, oil, heavy metals, pathogens and general debris, it is imperative to reduce impervious surfaces and non-point source pollutants running off of these areas. The primary motif throughout all green growth practices pertain to this step in the design process.

There are several street and parking design patterns that lend themselves to reducing impervious area and increasing common open and/or preserved green space. Use of the best features of these patterns can result in numerous environmental, social, and economic benefits when compared to conventional subdivision development. Street and parking design patterns that facilitate low impact development include (CWP, 1998):

- The grid or traditional urban pattern features short block lengths, straight streets and a systematic layout (This pattern generates greater dispersal of traffic, increased number of routes to a given destination, greater safety for pedestrians, ease of use of public transportation, and an increase in the number of homes fronting a street by using narrower lots), (Figure 2.3.a)

Figure 2.3a Aerial View of Grid Street Pattern

Image Created By: Patrice Cook

- The curvilinear "modified grid" pattern is similar to a grid pattern which features longer block lengths (The curvilinear pattern allows a site designer to better follow the topography of the site to avoid sensitive environmental areas, thereby, reducing clearing, excavation, and filling activities associated with road construction), and (Figure 2.3.b)

Figure 2.3b. Aerial View of Curvilinear Street Pattern

Image Created By: Patrice Cook

- Hybrid street networks combine both grid and curvilinear to better accommodate the natural features of a site.

Green Growth Guidelines encourages designs that reduce impervious surfaces and increase usable open spaces. Among the many practices that can achieve this goal are better road design and green parking techniques.

2.3.1 Street Width and Length

Significant reduction to impervious cover can be accomplished by minimizing street width and length. (Figure 2.3.1.a) Accordingly, streets should be designed as narrow and short as possible for intended use. Careful design of streets can satisfy concerns regarding parking, safety, and traffic congestion. Conventional standards include a 32' wide roadway composed of two 7' parking lanes on either side of two 9' wide moving traffic lanes. With only one 8' wide parking lane, two 10' wide travel lanes are standard.

Figure 2.3.1a Narrow Residential Streets with Adjacent Bio-swales

Photo Courtesy of: Washington State University

Recommended practices for designing road width and length include (CWP, 1988):

- Base design on average daily traffic volume calculated by the number of actual trips per day,
- Provide safe and efficient access for emergency vehicles,
- Design for the minimum required pavement to support traffic and parking, and
- On-street parking lanes should serve as traffic lanes (also known as a "queuing lane").

For urban streets with parking on both sides actual width is recommended at 32'. The recommended actual width of a neighborhood street with parking on one side is 24', while local street width is recommended at 18' and a gravel alley has recommended width of 14'.

Benefits from these practices include (CWP, 1998):

- Reduction in impervious cover,
- Reduction in the speed of traffic provides greater safety for pedestrians,
- Significant savings in cost of paving, clearing and grading, infrastructure, long-term pavement maintenance and stormwater management.

A savings of approximately $150 per linear foot can be achieved by shortening roads (CBP, 1993). [This includes savings achieved through reduced pavement and stormwater control].

2.3.2 Right-of-Way Width

A street right-of-way is an area where streets, sidewalks, utilities, and sometimes stormwater features are located. Often, the entire right-of-way is cleared in preparation for grading and road construction, potentially resulting in unnecessary loss of trees and vegetation. Limiting the cleared land width reduces the amount of land disturbed. Reducing the right-of-way makes more land available for housing lots and facilitates designing a compact land plan.

Conventionally, a right-of-way width of 50-60 feet is applied to all residential streets. Recommended design practices include (CWP, 1998):

- Reduce cleared width to minimum required to facilitate roadway, sidewalk, and vegetated open channels,
- Utilities should be "bundled" and located within the pavement section of the right-of-way when possible,
- Reduce rights-of-way by 10 to 25 feet by decreasing pavement and sidewalk width and bundling utilities within the pavement section, and
- Encourage the use of natural stormwater practices within rights-of-way such as bioretention swales and grassed filter strips that reduce the use the cleared area to treat stormwater runoff.

Recommended design options for a narrower right-of-way on residential streets (CWP 1998 pp 43-47) include: (Figures 2.3.2.a-c)

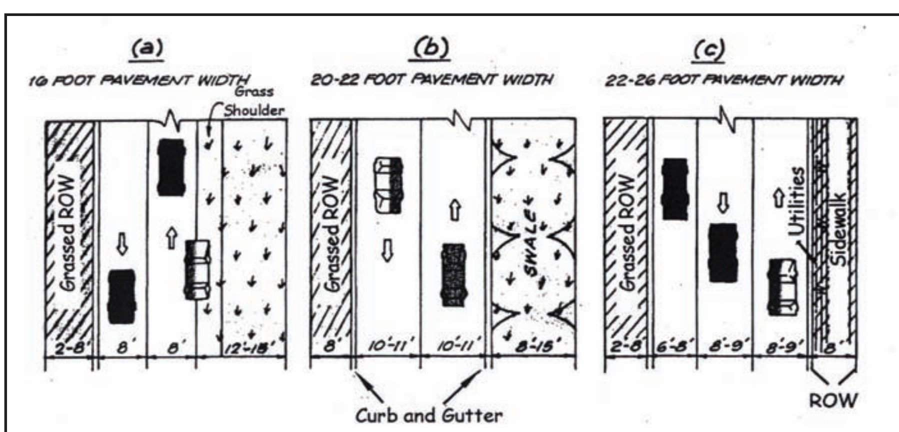


Figure 2.3.2a-c
Road Scenarios

Image Courtesy of: Better Site Design, Schueler, 1995

- **36’ Road Scenario**

  16’ Pavement Width – Two 8’ Wide Travel Lanes

  One 8’ Grassed Utility Easement

  One 12’ to 18’ Grass Shoulder with Parking

- **38’ Road Scenario**

  20’ to 22’ Pavement Width – Two 10’ to 11’ Wide Travel Lanes

  One 8’ Grassed Utility Easement

  One 8’ to 15’ Swale

- **42’ Road Scenario**

  22’ to 26’ Pavement Width – Two 8’ to 9’ Travel Lanes with One 6’ to 8’ Emergency or Parking Lane

  One 8’ Grassed Utility Easement

  One 8’ Sidewalk

Primary benefits include:

- Opportunity for on-site stormwater control and treatment,
- Reduces area to be cleared, resulting in a cost benefit, and
- More land available for development or green space.

2.3.3 Cul-De-Sacs & Alternative Turnarounds

A cul-de-sac is a dead-end residential street often used in conventional subdivisions. Typically, the terminal end is a large “bulb” that carries a radius of 50’ to 60’, entirely impervious and almost never fully utilized for turning purposes. There are alternative turnaround designs that serve the intended purpose while significantly reducing the area of impervious cover. (Figures 2.3.3.a and 2.3.3.b)

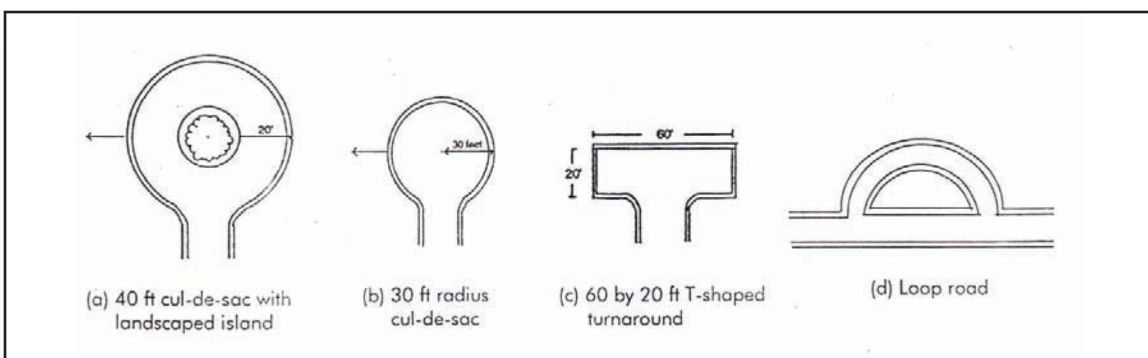


Figure 2.3.3a Subdivision Turnaround Designs

Photo Courtesy of: Better Site Development,

Figure 2.3.3b Conventional Cul-de-Sac in Subdivision

Photo Courtesy of: Pbase.com

Turnaround Option	Impervious Area (1,000 sf)
40' Radius Cul-De-Sac	5.024
40' Radius Cul-De-Sac with Island	4.397
30' Radius Cul-De-Sac	2.826
30' Radius Cul-De-Sac with Island	2.512
Minimum T-Shaped Turnaround	1.250

Table 2.2: Impervious Cover Created by Various Turnaround Options (Schuleler, 1995)

Recommended practices include (CWP, 1998):

- Reduce the radius of the turnaround bulb to 45' or less,
- Use interconnected streets to minimize the number of cul-de-sacs,
- Place a pervious island in the center of the turnaround and landscape with water-absorbing plants to facilitate storage and treatment of stormwater, (Figure 2.3.3.c) and

Figure 2.3.3c Cul-de-Sac with Maple Tree

Image Courtesy of: Pbase.com

- Consider alternatives to circular cul-de-sacs like the T-Shaped turnaround, which can generate 75% less impervious cover than a 40’ radius circular turnaround and the loop road, which provides multiple accesses and can carry twice the traffic volume of a cul-de-sac. (Figure 2.3.3.d)

  Benefits include (CWP, 1998):

- Reduced impervious surface area,
- Attractive to homebuyers due to lower traffic and sense of privacy, and
- Landscaped islands can be designed as rain gardens for stormwater control.

Figure 2.3.3d T-Shaped Turnaround in Subdivision

Image Created by: Patrice Cook

2.3.4 Sidewalks and Driveways

Excessive sidewalk and driveway requirements can increase the amount of impervious area within a site, further preventing infiltration of stormwater runoff into the soil. As much as 20% of the impervious cover in a residential subdivision consists of driveways and sidewalks (CWP, 1998). Recommended practices include:

- Locate sidewalks on only one side of the street,
- Use sidewalk widths of 5 feet in high-use areas, and 4 feet in other areas,
- Specify narrower driveway widths,
- Reduce the length of driveways by relaxing street and side yard setbacks,
- Allow use of permeable surfacing materials, such as crushed rock or shell, for sidewalk and driveway construction,
- Create driveways as two parallel strips with vegetation between them instead of one large expanse of concrete, and
- Sidewalks should be graded so that they drain to the adjacent bioretention swales or rain gardens, as opposed to the street.

Benefits from these practices include (CWP, 1998):

- Reduces impervious area,
- Allows for greater on-site infiltration of stormwater if bio-swales and rain gardens are used, and
- Cost savings in construction and maintenance due to reduction in amount of paving.

2.3.5 Parking and Parking Lots

Since parking lots, like streets and on-street parking, can be the largest impervious collectors of pollutants and debris, it is imperative to reduce these impervious surfaces and non-point source pollutants running off of these areas with common, practical, strategies referred to as “green parking”.

Parking ratios are the number of parking spaces that must be provided based on land use as established by local governing bodies. They are typically based on the minimum number of spaces needed to support peak parking hour(s). Studies summarized below have shown that typically, far more spaces are built than are actually needed:

Conventional Minimum Parking Ratios			
	Parking Requirement		**Actual Average Parking Demand**
Land Use	**Parking Ratio**	**Typical Range**	
Single Family Homes	2 spaces per dwelling unit	1.5 – 2.5	1.11 spaces per dwelling unit
Shopping Center	5 spaces for 1000 ft	4.0 – 6.5	3.97 per 1000 ft GFA
Convenience Store	3 spaces for 1000 ft	2.0 – 10.0	-
Industrial	3.3 spaces for 1000 ft	0.5 – 2.0	1.48 per 1000 ft GFA
Medical Office	1 space for 1000 ft	4.5 – 10.0	4.11 per 1.48 per 1000 ft GFA
GFA = gross floor area of a building without storage or utility spaces.			

Table 2.3: Conventional Minimum Parking Standards (ITE, 1987; Smith, 1984 and Wells, 1994)

Recommended practices include (CWP, 1998): (Figure 2.3.5.a)

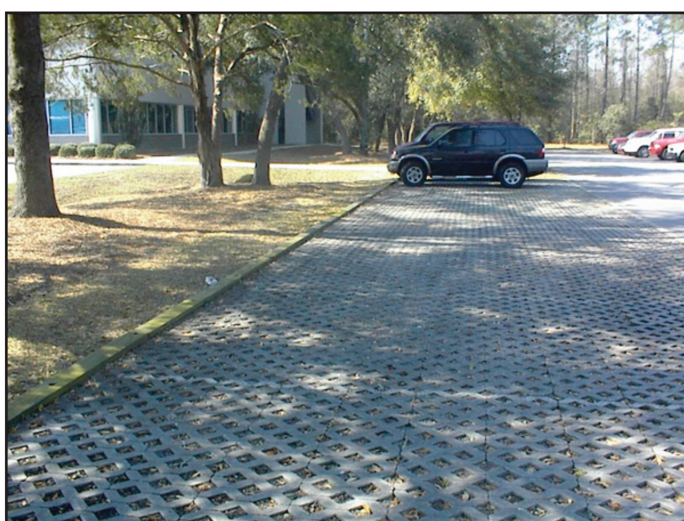
Figure 2.3.5a Reduced Parking Stalls with Permeable Paving Strips

Photo Courtesy of: Washington, D.C. Navy

- Limit the number of required parking spaces to meet actual average parking demand,
- Reduce the dimensions of parking stalls by 6" to 1' off their current length and width,
- Create more spaces for compact cars,
- Pervious materials are recommended for use to pave a variety of lower usage areas including overflow parking, emergency and service lanes. (A wide variety of alternative materials are available including modular pavers, gravel, crushed shell, grass pave, turf blocks, and porous concrete), (Figure 2.3.5.b)

Figure 2.3.5b Permeable Pavers Used for Overflow Parking

Photo Courtesy of: Dan Fischer



- Reduce the volume of stormwater runoff by requiring landscaped areas be used for stormwater management. (Landscaped areas can include parking islands which can be used as bioretention areas, dry swales, or filter strips), and
- Encourage shared parking and promote structured parking (multi-level lots). (In urban areas, especially commercial areas, high parking ratios make green parking techniques, especially shared parking and structured parking, a practical approach to reducing overall impervious coverage.)

Primary benefits from reduction of excess parking spaces, minimization of parking stall dimension, and encouragement of shared parking and multi-level garages include (CWP, 1998):

- Decreases impervious cover and related stormwater runoff,
- Reduces construction and maintenance cost. [Cost per conventional space can range from $1,200 to $1,500, an indication that a reduction in the required number of spaces would result in a cost savings in construction or maintenance (Markowitz, 1995)], and
- Conserves land; building a parking structure is costly but takes up no more impervious area than a single level parking lot. (Therefore, in an urban setting, multi-level structures may be a financial incentive for developers).

2.4 Lot Development

The third step in the green growth design process involves locating individual homes sites within the buildable area of the tract. Primary consideration is given to the natural contours of the land, especially when siting building lots to minimize land-disturbing activities such as clearing and grading. In addition, the dimensions of a lot can be modified to reduce overall impervious areas and then used to accommodate stormwater management features.

Conventional subdivisions require certain distance setbacks along all sides of the lot that often restrict a site designer's ability to design compact developments and reduce impervious surfaces and related runoff problems. The requirements should be adjusted to reasonable distances in an exchange for less paved area and more green space.

Recommended practices include (CWP, 1998): (Figure 2.4.a)

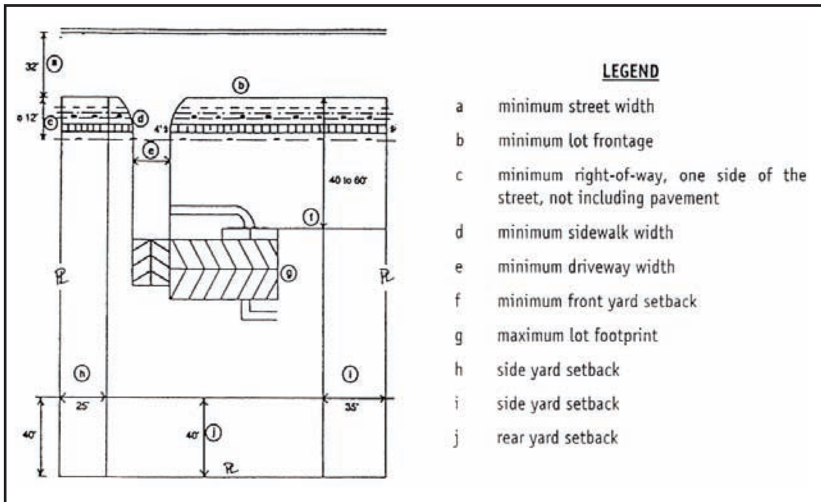


Figure 2.4a LID Lot Design

Image Courtesy of: Better Site Design, Schueller, 1995

(Note: Some of these practices may require variances from local ordinances.)

- Allow for relaxed front, side, and rear yard set backs,
- Allow for narrower frontages,
- Minimize driveway lengths to reduce overall lot imperviousness by relaxing front setback requirements,
- Encourage the use of common green or open space, and
- Use low impact stormwater strategies such as rooftops gardens, rain gardens, and bioretention swales to reduce the adverse effects of runoff.

Benefits of these practices include (CWP, 1998):

- Reduction in total impervious area by 40% or more when compared to conventional subdivision lot layouts, particularly if narrower streets can be utilized,
- Lower construction cost by reduced clearing, grading, and paving,
- Conserves trees and natural areas,
- Can protect watershed by reducing annual stormwater runoff volume by as much as 60% and, accordingly, stormwater pollution by a corresponding amount, and
- Highly desirable amenity of green space creates higher market value for lots and faster value appreciation.

2.5 Stormwater Management

Human impact can disrupt or destroy many of the processes that allow the natural landscape to perform its hydrological function of releasing cleansed water to the ocean and to the local groundwater. Stormwater runoff generated from impervious cover can be a significant threat to the quality of wetlands, surface water, and groundwater. Research has shown:

- Wetlands can be adversely affected by the quality and quantity of stormwater it receives from upstream areas (Azous, 1997).
- Sole source aquifers can be contaminated if stormwater pollutants are discharged underground (Written and Horsley, 1995).
- Stormwater pollutants can be directly attributed to the closure of beaches and shellfish beds.
- Fish and wildlife habitat can be degraded from erosion and sedimentation.

Stormwater management should seek to control both the quality and quantity of stormwater runoff created from new development activity. Quantity control is achieved by use of "constructed" wetlands and ponds, which help minimize flooding and protect downstream channels from accelerated erosion. Quality control is achieved through implementation of stormwater best management practices (BMP) like enlarged vegetated buffers, bio-retention swales, and infiltration basins that use natural processes to remove harmful non-point source pollutants. (CWP, 1998). (Figure 2.5.a)

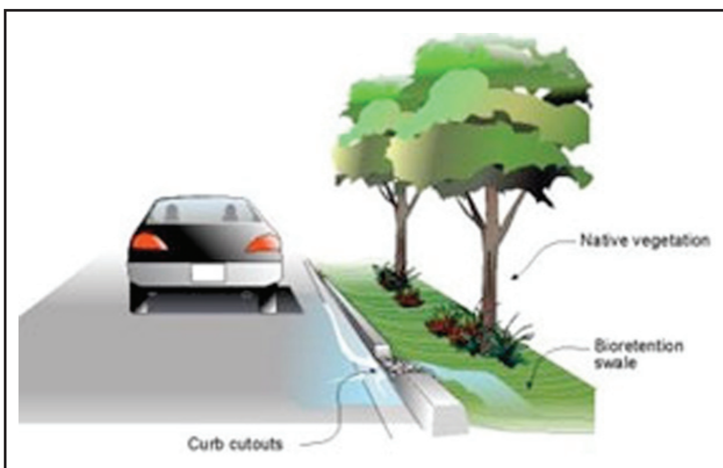


Figure 2.5a Curb Cuts Schematic

Image Courtesy of: Pierce County WA and AHBL, Inc.

To become more effective, stormwater management must incorporate low impact site design in its process for solving stormwater problems "*at the source*". With its focus on reduction of impervious cover and utilization of green space for stormwater treatment, low impact site design practices can greatly facilitate reduction of the volume of stormwater runoff that must be treated.

The following practices can be implemented at the site design stage:

- Where feasible, alleys, parking stalls, paths, driveways, sidewalks, and light-duty service roads should employ permeable paving,
- Overflow parking should have perimeter filter strips or bioretention areas,
- Use bioretention swales or filter strips along alleys and in parking lot medians to provide stormwater treatment and storage, (Figure 2.5.b) and
- Preserve areas with native vegetation for runoff control and buffering of environmentally sensitive areas.

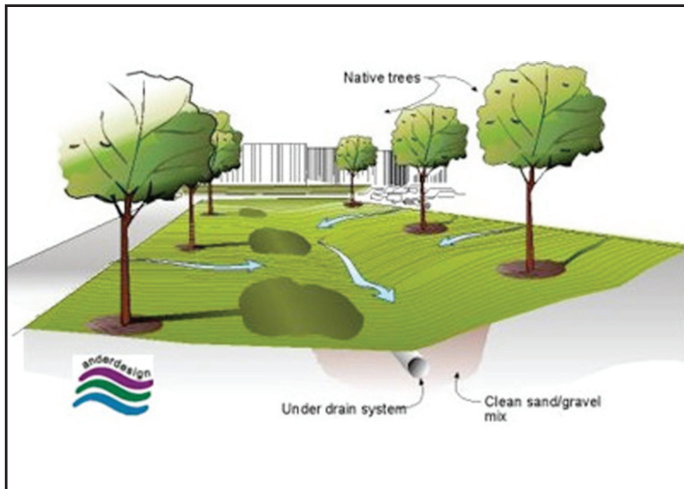


Figure 2.5b Bio-swale Schematic
Image Courtesy of: Pierce County WA and AHBL, Inc.

While these are basic examples of how site design practices can improve stormwater management, BMPs are the primary method of stormwater control. These practices, their physical description, application, and resulting benefits, are discussed in detail in Chapter 3.

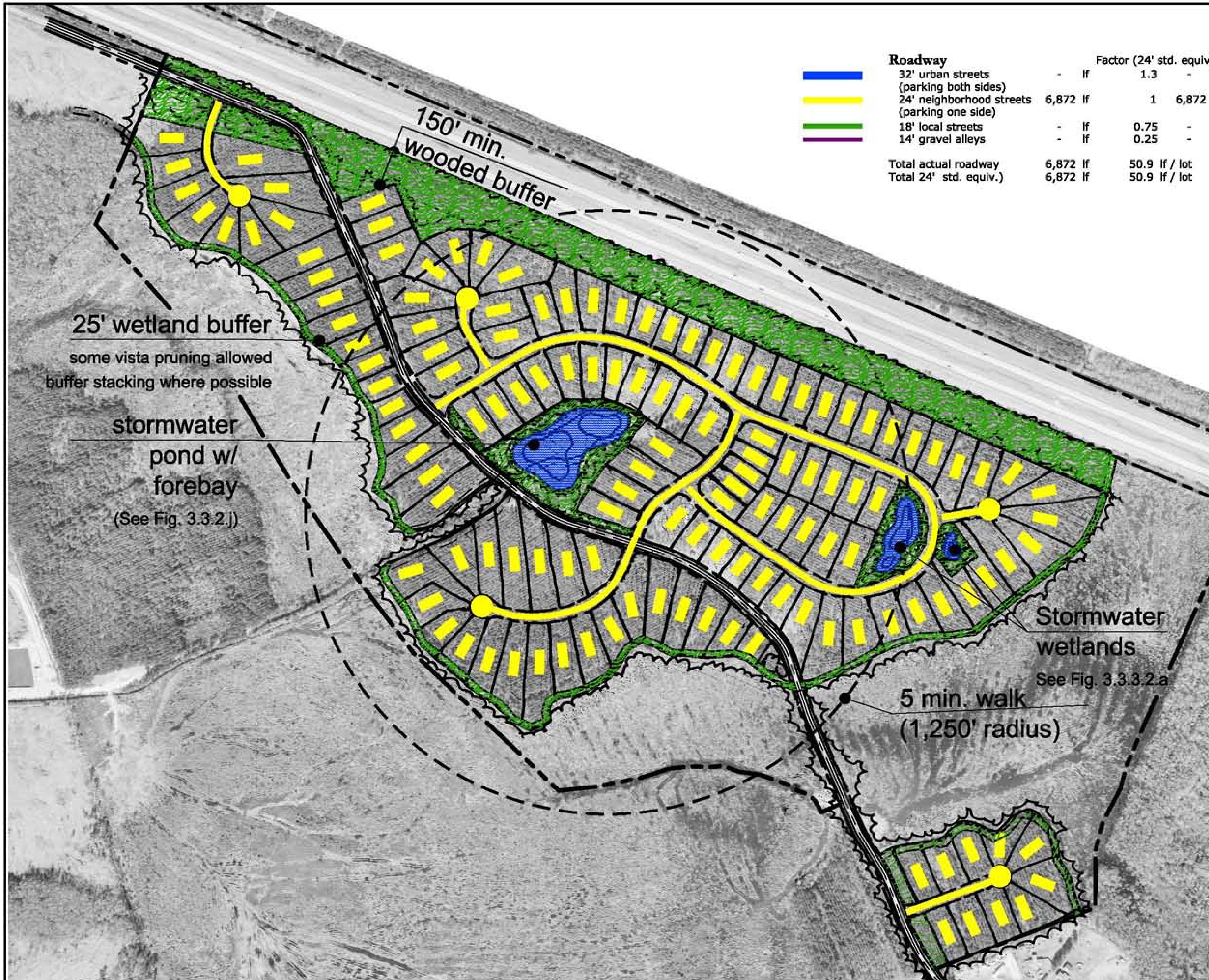
2.6 Design Comparison

In this section, we compare the “conventional” method of development to two residential land plans that use the “conservation design” and the “new urbanist” approach to lot development – two methods that have received an increasing amount of attention in recent years. The two forms created for the Tupelo Tract are termed the “Community Preserve” and the “Village”. Both of these plans promote two main principles: 1) to use land more efficiently by building compact communities and 2) tailor fit the development plan to the site’s natural characteristics. These land plans were applied to the Tupelo Tract and are compared to one another to show the economic, environmental, and social benefits of *designing with the landform.*

The most obvious advantage of the non-conventional design is the preservation of natural green space and the resultant water quality benefits. Other benefits of the non-conventional low impact, compact development approach include:

- The per-lot cost of infrastructure including roads, piping and other utilities is substantially reduced,
- Extensive surrounding green spaces gives residents a feeling of being connected to nature,
- The reduction of impervious surfaces per lot and the incorporation of alternative stormwater measures into the landscape design lessen the negative impact on the environment,
- The sizing of the community to allow for and promote walking, bicycling and other non-automotive transportation can reduce local automobile usage and consequently road maintenance and air pollution,
- Compact designs promote the interaction and proximity of residents, and large amounts of open space promote the development of the human relationships that comprise a real community, and
- Compact design considers and incorporates forested buffers and green space areas that serve as critical habitat for local wildlife.

The following is an overview of these development types both individually and comparatively amongst each other. It includes the definition of the strategy with visual support of the designs shown in Figures 2.6.2 a-c.



Green Growth Guidelines

a Low Impact Development Strategy for Coastal Georgia

Conventional Concept

SITE DATA

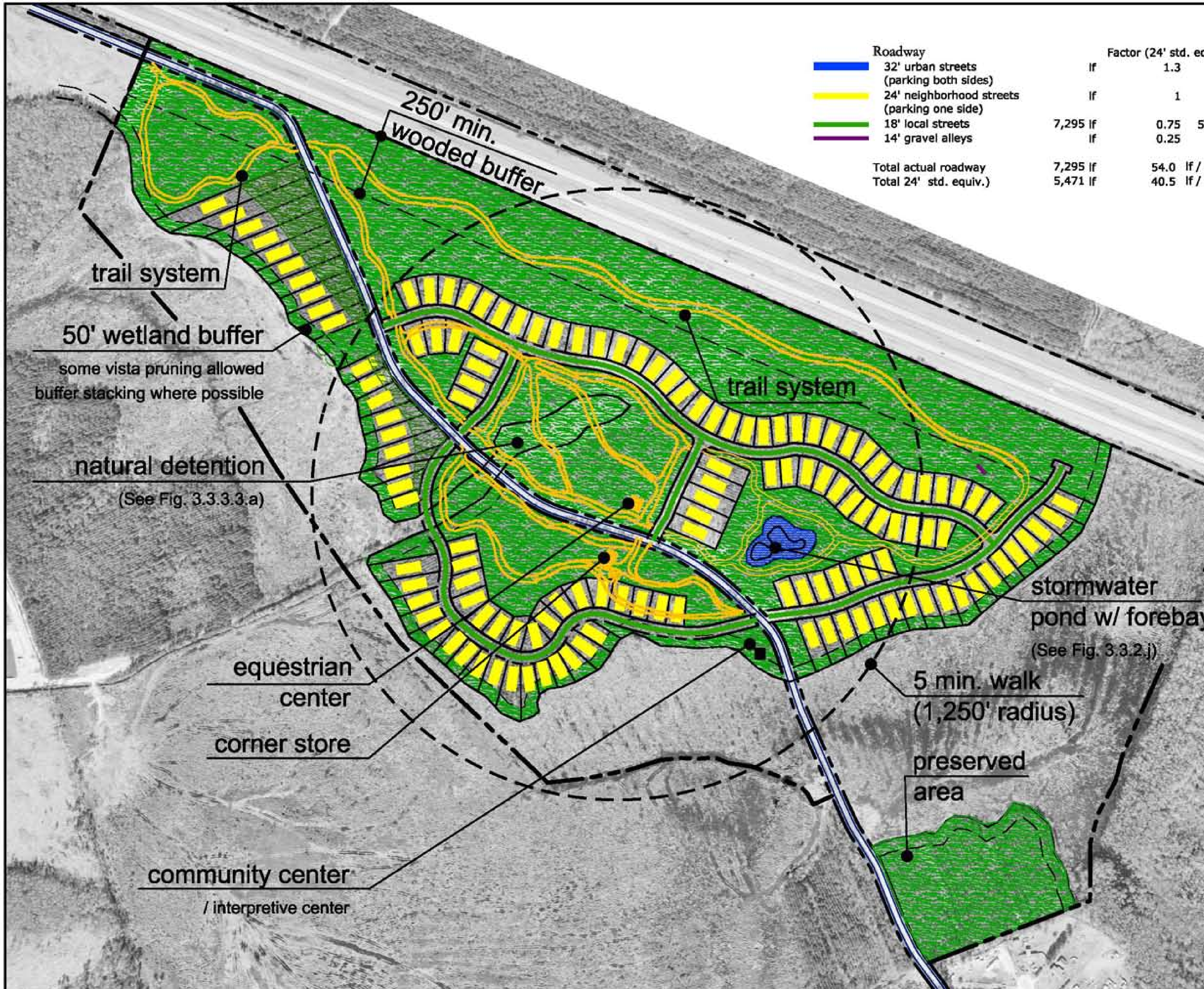
Description	Count	
Total Site Area	188.6	acres
Total Wetland	64.7	acres
Total Upland Area	123.9	acres
Total Disturbed Site Footprint	101.3	acres
% Disturbed on total site	53.7%	
Total Lots	135.0	du
Density		
gross (on total site)	0.7	dua
net (on total upland)	1.1	dua
Green Space	22.6	acres
upland green space	18%	
total site including wetlands	46%	
On-Lot Green Space	27.2	acres
Total including on lot	49.8	acres
upland green space incl. on-lot	61%	
Unit Count		
Single family		
100' lots	130	du
75' lots	5	du

Conventional

Conceptual Master Plan Tupelo Tract

Figure 2.6.2.a

Matthew R. Baker, ASLA



Roadway			Factor (24' std. equiv.)	
32' urban streets (parking both sides)		lf	1.3	-
24' neighborhood streets (parking one side)		lf	1	-
18' local streets	7,295	lf	0.75	5,471
14' gravel alleys		lf	0.25	-
Total actual roadway	7,295	lf	54.0	lf / lot
Total 24' std. equiv.)	5,471	lf	40.5	lf / lot

Green Growth Guidelines

a Low Impact Development Strategy for Coastal Georgia

Community Preserve

SITE DATA

Description	Count
Total Site Area	188.6 acres
Total Wetland	64.7 acres
Total Upland Area	123.9 acres
Total Disturbed Site Footprint	48.9 acres
% Disturbed on total site	25.9%
Total Lots	135 du
Density	
gross (on total site)	0.7 lots / acre
net (on total upland)	1.1 lots / acre
Green Space	75.0 acres
upland green space	61%
total site including wetlands	74%
On-Lot Wooded Area	9.3 acres
Total including on lot	84.3 acres
with on-lot	79%
Unit Count	
Single family	
70' lots	135 du
Mixed Use	
Corner store	1 1 story
Equestrian Center	1

Community Preserve

Conceptual Master Plan Tupelo Tract

SCALE 1"=400'

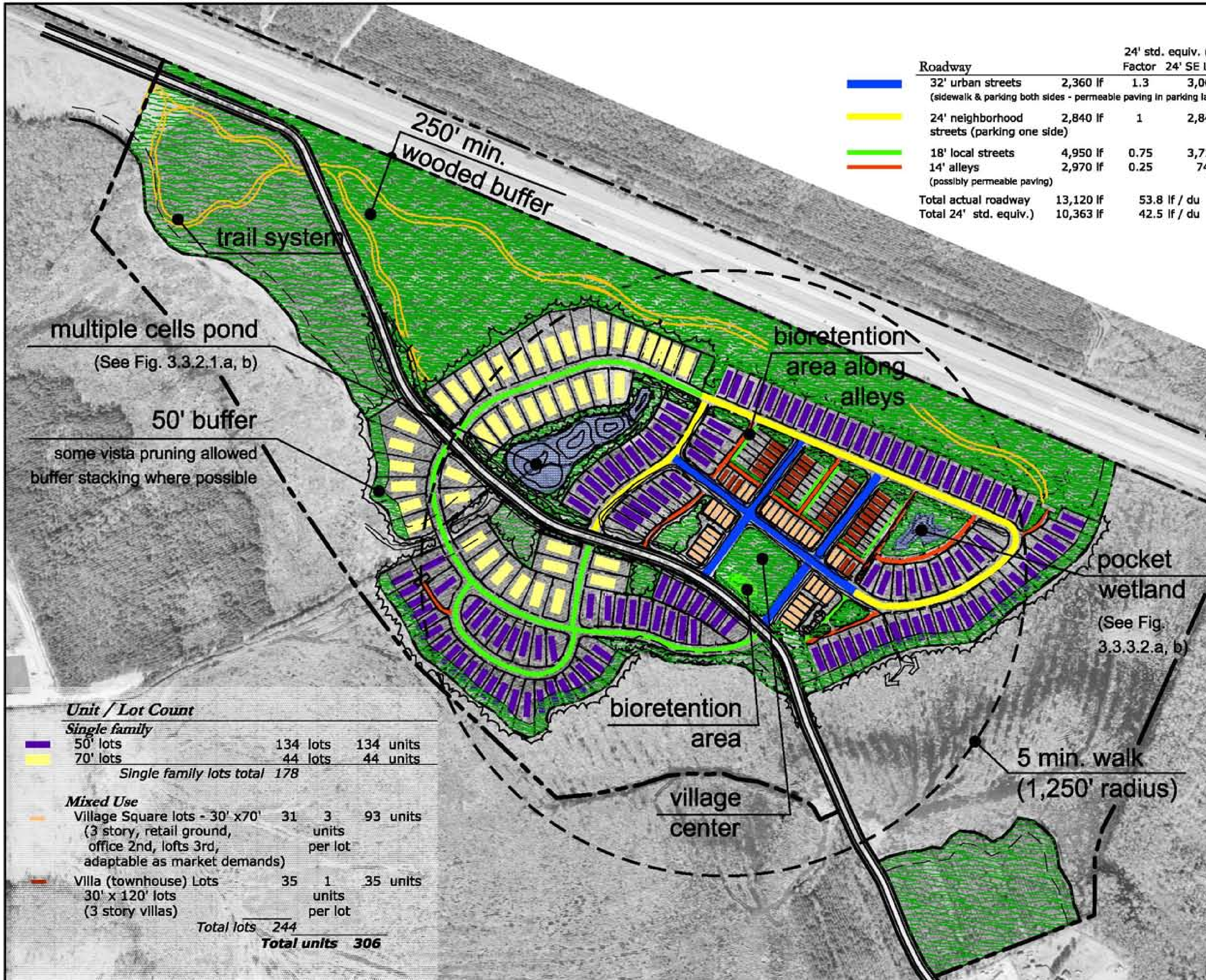
NORTH 0' 200' 400' 600'

Figure 2.6.2.b

Matthew R. Baker, ASLA

Green Growth Guidelines

a Low Impact Development Strategy for Coastal Georgia



Roadway		24' std. equiv. (SE) Factor	24' SE Length
32' urban streets (sidewalk & parking both sides - permeable paving in parking lanes)	2,360 lf	1.3	3,068 lf
24' neighborhood streets (parking one side)	2,840 lf	1	2,840 lf
18' local streets	4,950 lf	0.75	3,713 lf
14' alleys (possibly permeable paving)	2,970 lf	0.25	743 lf
Total actual roadway	13,120 lf	53.8 lf / du	
Total 24' std. equiv.)	10,363 lf	42.5 lf / du	

Village

SITE DATA

Description	Count
Total Site Area	188.6 acres
Total Wetland	64.7 acres
Total Upland Area	123.9 acres
Total Disturbed Site Footprint	64.0 acres
% Disturbed on total site	33.9%
Total Lots	244 lots
Density	
gross (on total site)	1.3 lots / acre
net (on total upland)	2.0 lots / acre
Green Space (upland, off-lot)	59.9 acres
upland green space	48%
total site including wetlands	66%
On-Lot Wooded Area	9.3 acres
Total including on lot with on-lot	69.2 acres 71%

Unit / Lot Count

Single family			
50' lots	134 lots		134 units
70' lots	44 lots		44 units
Single family lots total	178		
Mixed Use			
Village Square lots - 30' x70' (3 story, retail ground, office 2nd, lofts 3rd, adaptable as market demands)	31	3 units per lot	93 units
Villa (townhouse) Lots 30' x 120' lots (3 story villas)	35	1 units per lot	35 units
Total lots	244		
Total units			***306***

Village

Conceptual Master Plan Tupelo Tract

Figure 2.6.2.c

Matthew R. Baker, ASLA

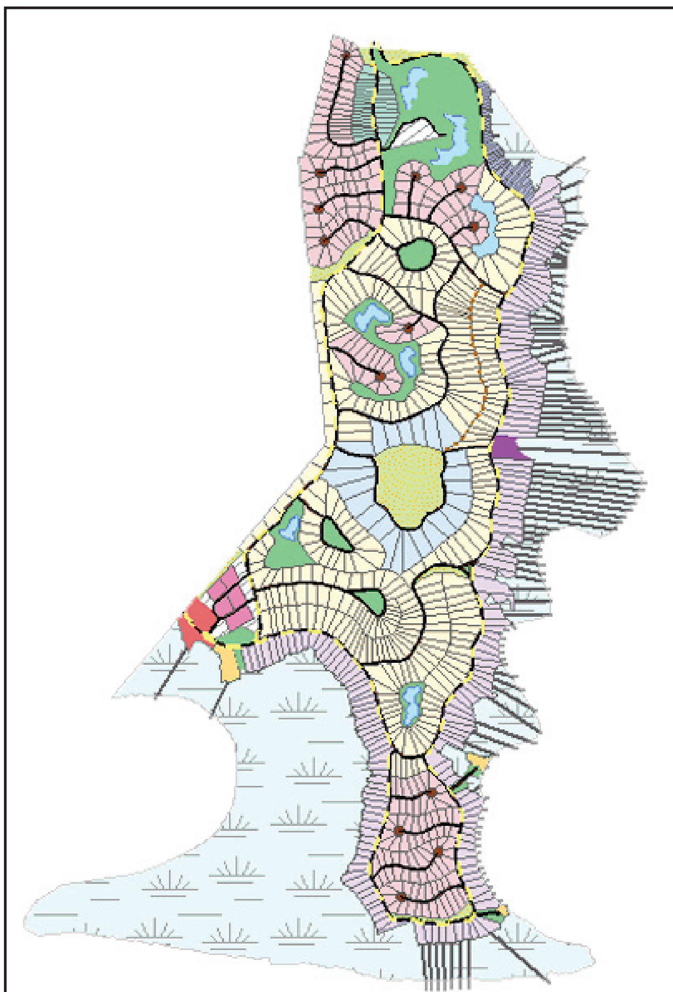
2.6.1 General Descriptions of Development Types

2.6.1.1 Conventional Subdivision

The arrival of the automobile after World War I changed America from a nation of “compact cities” to the widely dispersed suburbs of the post World War II “Highway Era”. Most residential development that has emerged in the suburban United States since World War II can be described as “checkerboard” housing development. Since it is so common, this pattern is also considered conventional development. Each lot has nearly uniform road frontage, specified street standards, and minimum setbacks from roads or neighboring property owners. These restrictions generally result in equal lot areas with homes placed in the same location on each lot regardless of the parcel’s characteristics. The resulting group of homes or lots is typically termed “subdivision”. In conventional subdivisions, individual homeowners privately own most or all of the land. (Blain, Thomas; Schear, Peggy 1999.) (Figure 2.6.1.1.a)

Figure 2.6.1.1a Conventional Site Design

Image Courtesy of: Georgia Coastal Management Program



Conventional subdivisions are characterized by homogenous land uses, emphasis on the private automobile, lower residential densities and a lack of interconnectivity to nearby developments. Generally, developments are built with separate land uses for residential, retail, office, civic, industrial, and multi-family uses. Features include large buffers between uses that prohibit connections by code, and streets and cul-de-sacs in residential areas that force one to use a main collector road to reach large commercial and institutional parking lots. Stormwater is usually handled by pipes and culverts that directly discharge to nearby waterways, marshes, or wetlands. This development pattern gives little or no consideration to environmental or cultural features of the site with respect to the placement of streets and building lots. Increased land disturbance, conventional stormwater practices, and increased impervious areas challenge the viability of this option environmentally, and often economically as well.

2.6.1.2 Conservation Subdivision

Conservation design uses a style known as "conservation development". The conservation subdivision shown here contains the same number of lots as a conventional subdivision, but smaller lots are clustered on one part of the parcel. A conservation subdivision is characterized by a compact footprint that retains significant areas of green or open space (at least 40% of the total site) for the purpose of protecting natural resources (CWP, 1988). Due to its limited impact, this style is the recommended option for areas such as islands, hammocks and other sensitive sites that will not support more intense development. These communities, by design, reduce overall impervious area and incorporate stormwater management features such as constructed wetlands and ponds, and roadside bioretention swales. (Figure 2.6.1.2.a)

Conservation subdivisions are a density neutral option most applicable to suburban fringe and rural areas. By using a smaller lot size, the design approach

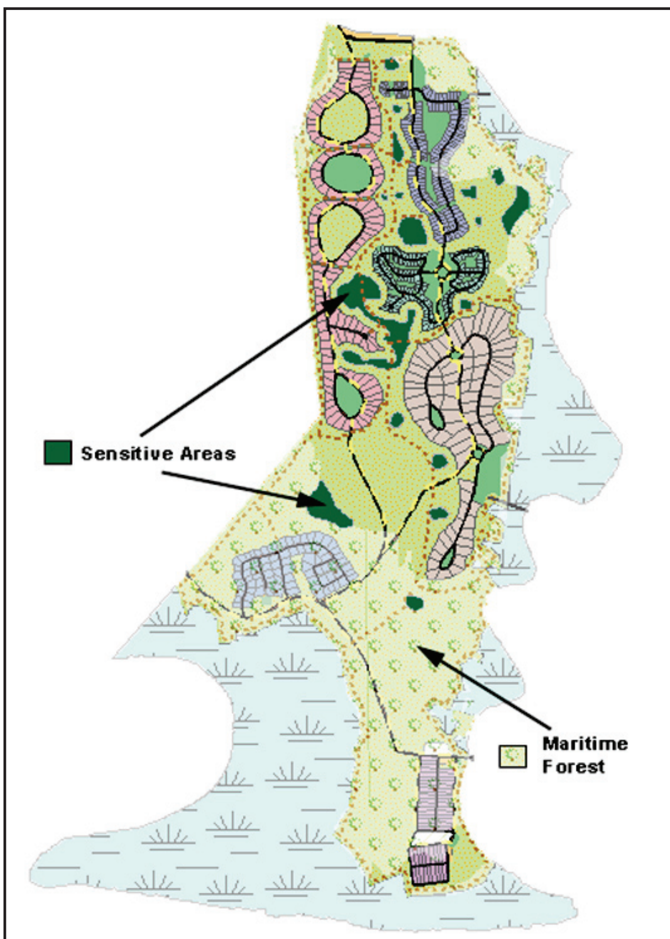


Figure 2.6.1.2a Community Preserve Site Design

Image Courtesy of: Georgia Coastal Management Program provides more open space with the same number of lots as conventional developments. The main idea is to create communities that preserve and protect naturally functioning ecosystems.

Given that this design allows the same number of residences as a conventional development under current zoning for most municipalities, and eliminates the need to obtain approval for higher density, it is more likely to be accepted by the local government authorities and the community due to high percentage of green space conserved. With its smaller lot size, some municipalities may require a special variance for this aspect, which is usually less effort than increasing density. This makes the Conservation Design a highly effective development solution for coastal Georgia that can be immediately implemented with little regulatory difficulty.

2.6.1.3 New Urbanist Subdivision

The New Urbanist approach, also known as Traditional Neighborhood Development, uses smaller lot sizes on one portion of the property to leave the remaining large green space areas (at least 20% or more of the total site). These areas improve the aesthetics of the property, serve as recreational areas for residents, protect natural resources and wildlife habitat, and support better stormwater management practices. Typically, road frontage and lot size is decreased to preserve ecologically sensitive areas, historical sites, or other unique characteristics of the land being subdivided. (Figure 2.6.1.3.a)

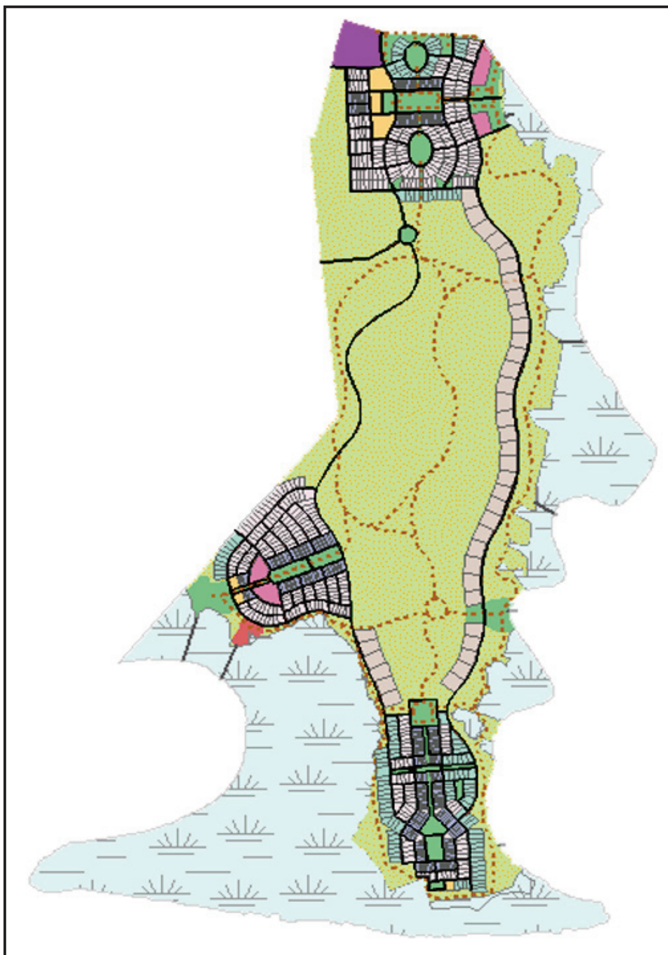


Figure 2.6.1.3a Village or Cluster Site Design

Image Courtesy of: Georgia Coastal Management Program

The Village is a concept derivative of traditional development styles. The Village is typically applied as an extension of an existing city or town, though it can also be applied to an area, such as a major intersection, where there is a desire to form a new "node" in the regional transportation network. Higher density is achieved through a grid system of streets scaled for pedestrians. It sites houses on smaller parcels of land, and the additional land that would have been allocated to individual lots is converted to common open space for residents in the form of parks or squares. It is typically mixed-use, with a combination of housing types and retail/commercial areas, and presents opportunities for residents to walk to basic services or possibly to work in the village center. Road frontage, lot size, setbacks, and other traditional subdivision regulations are redefined to allow for higher density with a mix of uses, and to preserve ecologically sensitive areas, historical sites, or other unique characteristics of the land. While this may require more effort to win approval in some municipalities, the Village creates lower impervious area and associated runoff *per lot* and does the most to mitigate the affects of sprawl.

2.6.2 Comparison of the Tupelo Site Plans

The Tupelo Tract is shown in maps and tables in Exhibits 1 through 14. The gross area of the tract is 188.6 acres, consisting of 123.9 acres of buildable or upland area (66% of the tract) and primary/secondary conservation areas totaling 64.7 acres (or 34% of the tract).

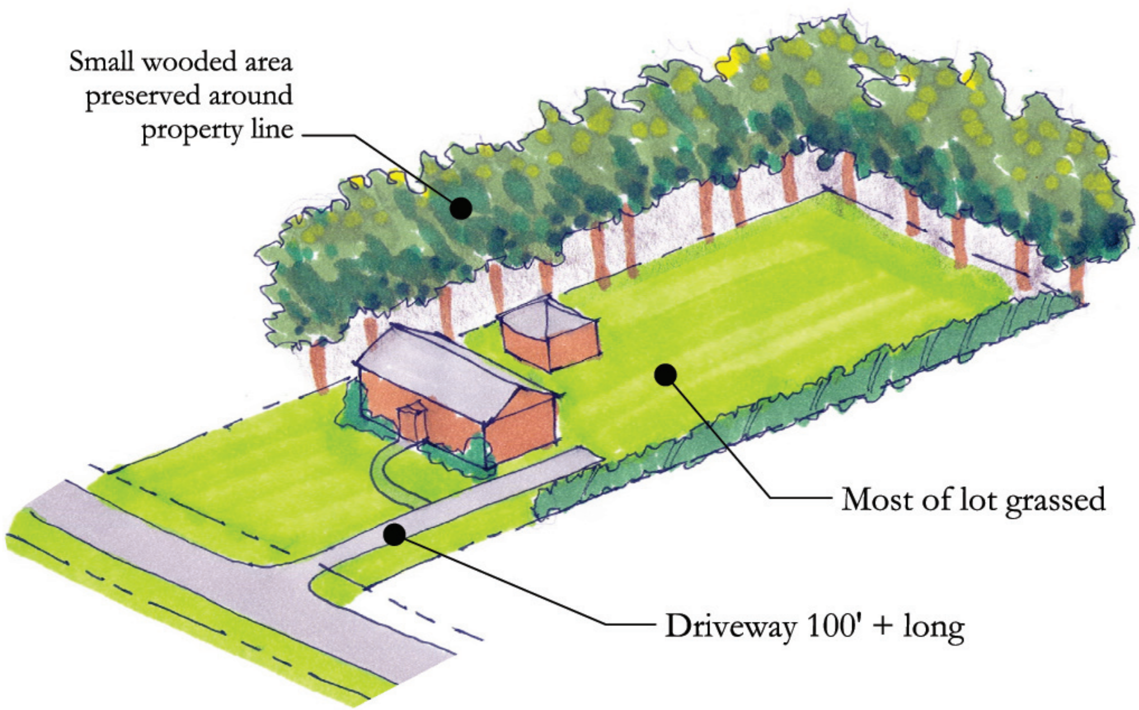
2.6.2.1 Conventional Plan

The conventional example on the Tupelo Tract illustrates typical suburban development with a few improvements to convention. Normally, one might see lots extending over the wetland preserve area; here the lots stop at the wetland edge. The buffer to the north separating the lots from the interstate is shown at 150' in width; typically, this buffer might be shown at 25' in width if any buffer were provided at all. The buffer along the wetland edge is shown at 25' wide; this buffer area is part of each lot as is typical for all three example plans though the other plans use a wider buffer. Common area on this plan is characteristically limited and includes 22.6 acres (18%) of upland area devoted to buffers and ponds.

Of the 123.9 acres of buildable area on the tract, the Conventional Plan uses 101.3 acres or 82% of the buildable upland area to support creation of 135 building lots. The Conventional plan utilizes every available portion of the buildable area for lot creation.

Density on the total site is 0.7 lots/acre (135 lots/188.6 acres total site); and 1.1 lots/upland acre (135 lots/123.9 total upland acres). This is a low density and is typical of what many municipalities require in current zoning regulations. The total disturbed site footprint is 101.3 acres or 53.7%.

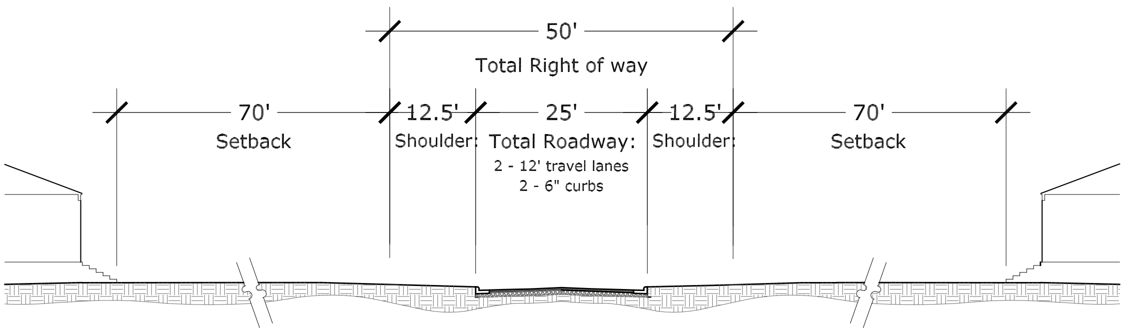
The average lot size is 100' by 275' (27,500 sf. or approximately 2/3 acre). This plan and the associated calculations assume conventional practices for on-lot development. Houses are set far off the street with minimum 70' setbacks. Driveways extending to the back yard then are 100' long by 10' wide for 1,000 square feet of driveway. Rooftop area for the house and outbuilding is 2,400sf. for a total impervious area of 3,400sf. on each lot. Two-thirds of each lot is clear-cut leaving only a small portion of woods along the back and sides of each lot with the remaining area grassed. (Figure 2.6.2.1.a)



Typical Lot Development - Conventional

Figure 2.6.2.1.a - nts Matthew R. Baker, ASLA

Streets in this plan total 6,872 linear feet of roadway. The plan uses only one size of roadway and shows a 24’ wide standard roadway with curb and gutter as is required in many municipalities. In the “non-conventional plans” following, this is referred to as the 24-foot standard equivalent (SE). This layout uses 51 linear feet of roadway per lot. Right of way for these roads is 50’ wide and is cleared and grassed. Parking is handled entirely on each lot, although overflow parking is allowed on one side of the street. (Figure 2.6.2.1.b)



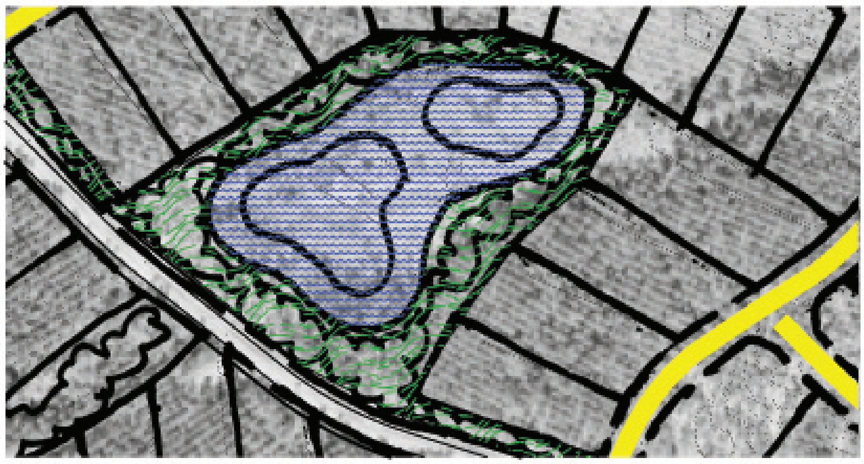
Typical Roadway Section - Conventional

Figure 2.6.2.1.b - nts   Matthew R. Baker, ASLA

Cul-de-sacs are used heavily, although this plan interconnects somewhat more than is typical. A few of the lots front directly onto the existing County Road 13. Another small group of lots have one side facing County Road 13; these have a 25’ side buffer. Normally in conventional plans, trails are not provided; such is the case on this plan. Cul-de-sacs are drawn at a 95’ diameter; this is a large expanse of pavement at the end of each road.

Post-development runoff from this plan is the highest of the three examples. Using the rational method, applying the appropriate cover factor for woods, impervious area and grassed area, the total runoff from all upland areas is 277.0 cubic feet/second (cfs). On a per lot basis, total runoff for the project is 2.1 cfs per lot. On-lot grassed area contributes the bulk of this runoff at 122.6 cfs or 44% of total runoff. The amount of runoff from grassed areas could be considerably reduced simply by preserving more on-lot wooded area and would represent a significant improvement in water quality.

Many conventional subdivisions include ponds to handle stormwater. This plan goes somewhat further, including wetland shelves and a forebay to improve runoff water quality. These ponds can also be quite beautiful when wetland plants are included and the shape of the pond is more refined. Therefore, the ponds in this plan are sited so they can be seen from the road (instead of being hidden in the back of the project). Ponds created with visual quality in mind can be a real asset to the community and serve as common open space. (Figure 2.6.2.1.c)



Stormwater Pond with forebay - Plan

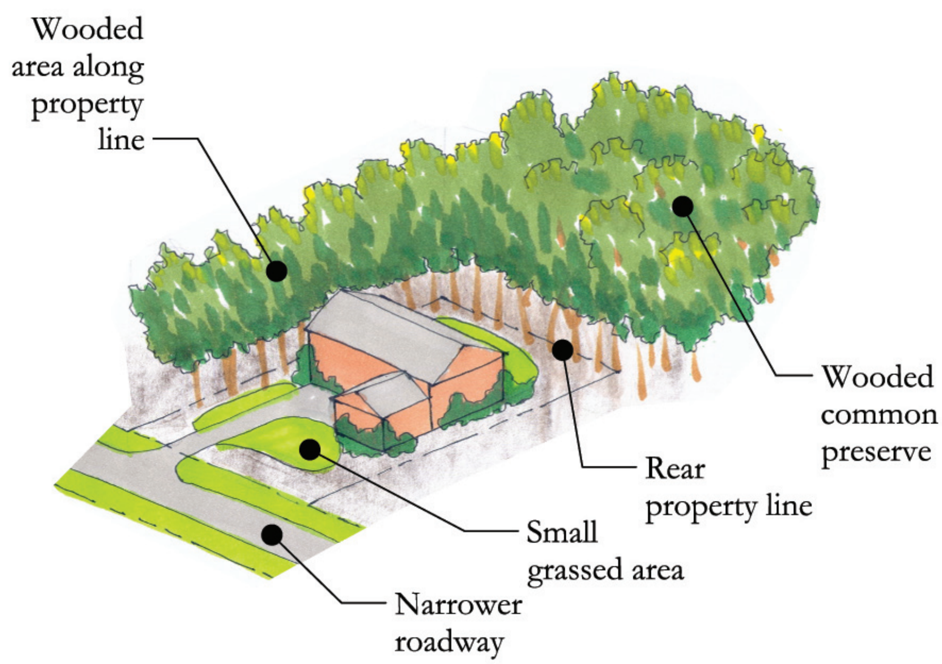
Figure 2.6.2.1.c - nts

2.6.2.2 Community Preserve

In the Community Preserve plan considerably more of the upland buildable area is preserved as common area; with 75.0 acres (61%) of upland area preserved as community green space (compared to 22.6 acres (18%) for the conventional plan). The small area in the southeast corner of the property is completely preserved. A minimum buffer from the adjacent interstate is shown at 250-feet wide with some lots having up to 450 feet of wooded buffer. A wetland buffer of 50 feet is used along the delineation line, with some vista pruning allowed to establish "view corridors".

The Community Preserve yields the same number of lots as the conventional development (135 lots), and the density is identical at 0.7 lots per total acre (135 lots/188.6 acres total site), and 1.1 lots per upland acre (135 lots/123.9 total upland acres). This is still a low-density plan, typical of what many municipalities require in current zoning regulations. However, certain subdivision standards may have to be relaxed to allow for smaller lot size, shorter setbacks from interior roads, and narrower paved widths on these roads.

Lots in the Community Preserve are 70' wide, but vary in depth, and therefore size. The average lot size is 70' x 125' (8,750sf. or 2/10-acre). This plan and the associated calculations for on-lot development assume a conservation approach: houses are set closer to the street than conventional using a 40' setback; driveways extend to the front of the house and are 60' x 10' for 600 square feet of driveway (as compared to 1,000sf for conventional); and rooftop area for the house and an outbuilding is slightly larger than the conventional plan at 2,550 square feet for a lower total impervious area of 3,150 square feet on each lot (3,400sf for conventional). Because so much of the total parcel is preserved and the lots area is much smaller, the percentage of cleared area is 2/3 of what is cleared in the conventional development. On-lot lawn area, however, is reduced over the conventional plan by 83% (2,600sf for the Community Preserve vs. 15,100sf for conventional). (Figure 2.6.2.2.a)



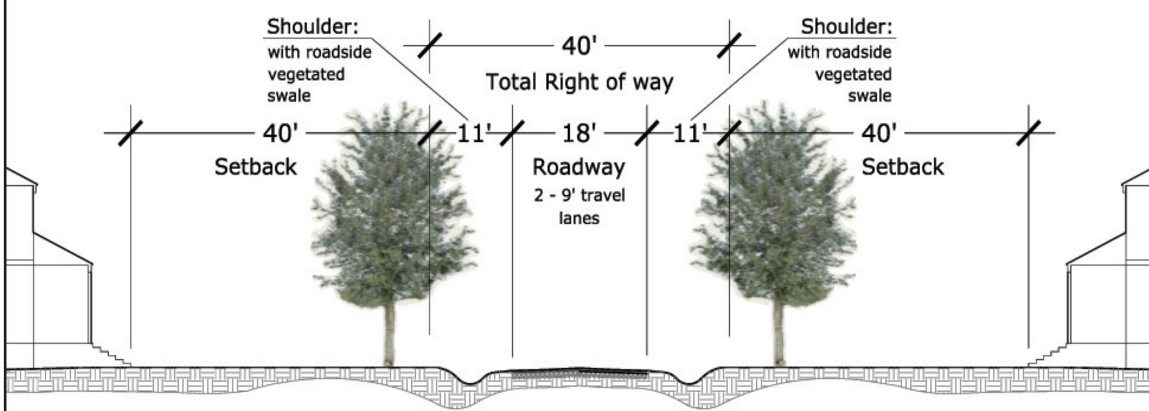
Typical Lot Development - Community Preserve

Figure 2.6.2.2.a - nts

Matthew R. Baker, ASLA

The Community Preserve limits the disturbed footprint by reducing lot sizes to nearly one-third of conventional subdivisions. Here the disturbed site footprint is less than half of conventional at 48.9 acres or 25.9% of the total parcel area (compared to 101.3 acres or 53.7% in the Conventional Plan).

There is 7,295 linear feet of road in the Community Preserve, which is more than the conventional plan (6,872 lf), but the Preserve uses an 18’ road section resulting in 40 linear feet of roadway per lot (using the 24’ SE – compared to 51 lf per lot for conventional). The 18’ roadway uses a shoulder section without curb and gutter, allowing for sheet flow off the streets and for the runoff to be filtered by adjacent grass swales before reaching other treatment practices. Right of way for these roads is still 50 feet wide but clearing is limited to a ±40’ width. Parking is still handled on each lot, although overflow parking is allowed on the shoulders. (Figure 2.6.2.2.b)



Typical Roadway Section - Local Street

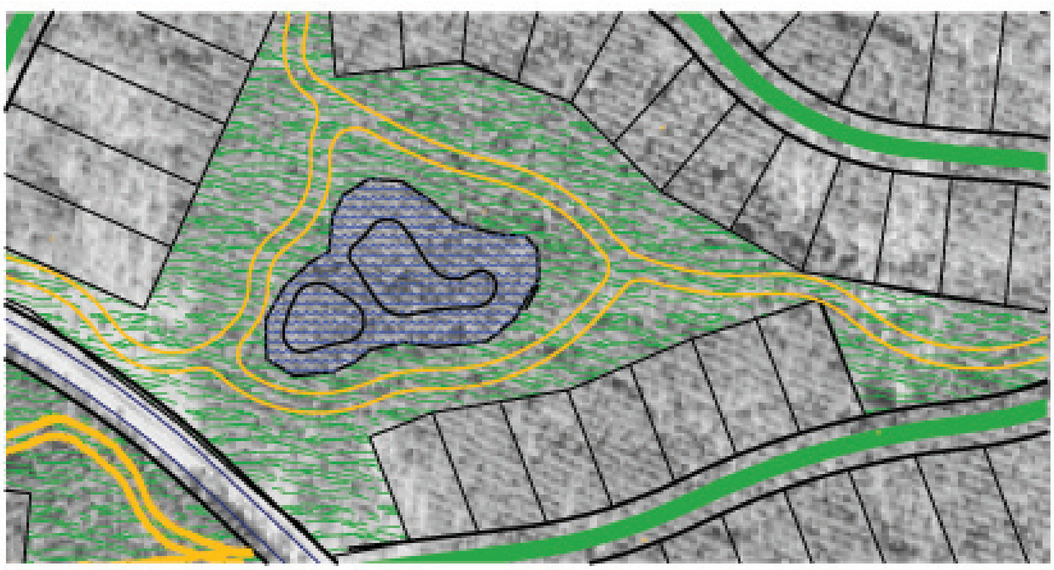
Figure 2.6.2.2.b - nts Matthew R. Baker, ASLA

Roads in the Community Preserve are interconnected and the development is free of cul-de-sacs except for one hammerhead style turnaround. This type of turnaround uses much less pavement than conventional cul-de-sacs reducing impervious area and stormwater impacts. A number of lots front directly onto the existing County Road 13, and those with one side facing County Road 13 have 50’ or more of community area as a side buffer. An extensive trail system is provided with the intention to connect with regional trails. The local trails on this plan serve residents and horseback riders originating from the equestrian center and provide walking access to the corner store. An additional lot set aside for community use has a community shelter/interpretive center at the wetland edge. These opportunities for interaction promote a sense of community among residents. These features add a social element to the plan that is lacking in the conventional plan. (Figure 2.6.2.2.c)

Figure 2.6.2.2c
Community Shelter

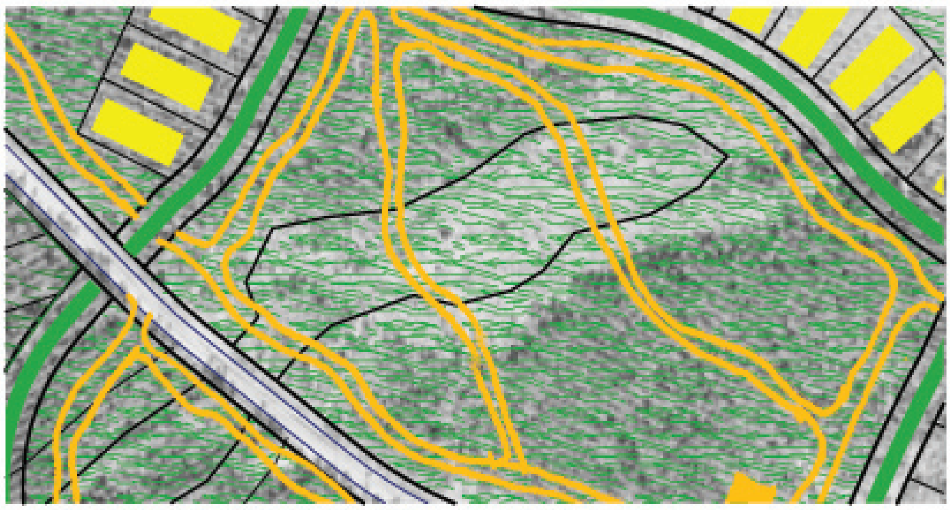
Photo Courtesy of:
Matthew R. Baker

Total post-development runoff from this plan is the lowest of the three examples provided in this manual. Using the rational method, applying the appropriate cover factors as above, the total runoff from all upland areas is 190.6 cfs or 69% of the total runoff for the conventional plan. On-lot impervious surface is the largest generator of runoff at 70.5 cfs or 37% of the total runoff. On a per lot basis, total runoff for the Community Preserve is 1.4 cfs per lot (2.1 cfs per lot in conventional). (Figures 2.6.2.2.d and 2.6.2.2.e)



Stormwater Pond with forebay - Plan

Figure 2.6.2.2.d - nts



Natural Detention - Plan

Figure 2.6.2.2.e - nts

The practices for managing stormwater are unique to this plan. The conservation style affords more opportunity to leave the stormwater on the surface, in contact with vegetation and exposed to sunlight, yielding water quality improvements while using simpler practices. Stormwater is managed on-site using a wetland pond with forebay and existing forested wetlands. The natural detention area is sited over an existing wooded depression with trails crossing it. The trails are laid out to provide small berms through the low area, detaining water behind them, and allowing the stormwater to infiltrate and interact with the vegetation remaining on the forest floor. (Figure 2.6.2.2.f) The trail berms have small pipes slightly above grade that allows water to slowly percolate into the ground and prevents the trail from overtopping in all but the largest storm events. Roadside shoulders, grassed filter strips, and bioretention swales provide pre-treatment for the natural detention system. For those lots backing up to the wetland, rain gardens and/or infiltration basins can be used on-lot and within the 50 foot wetland buffer using the buffer stacking technique discussed earlier.

Figure 2.6.2.2f Trail for Active Recreation also Serves as Berm for Natural Detention

Photo Courtesy of: Tara Merrill

2.6.2.3 Village

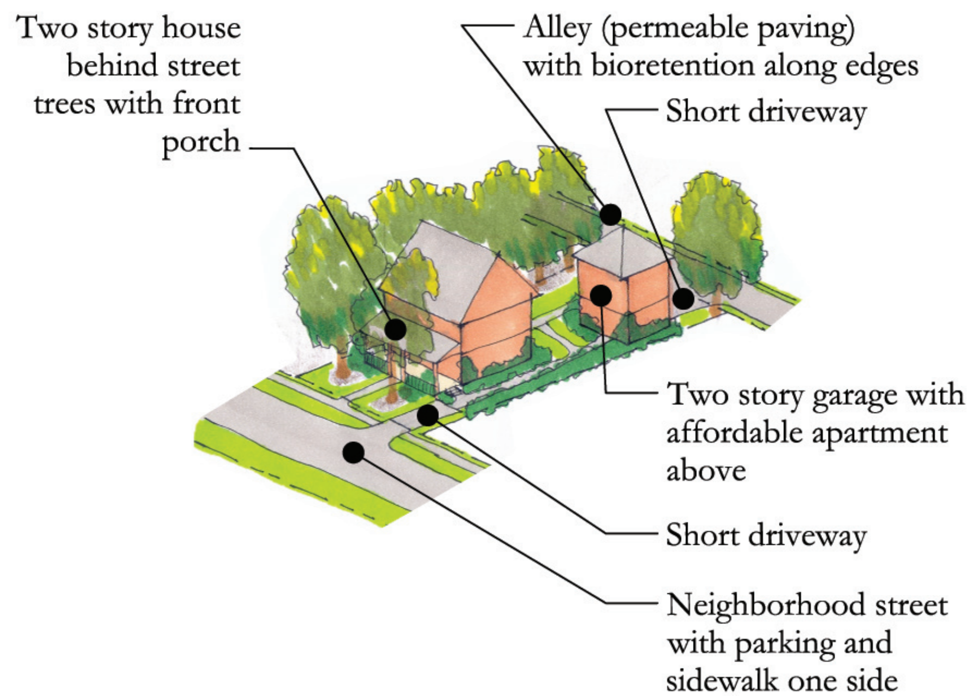
The Village development yields more lots and significantly more dwelling units than the other two development styles explored above. The village plan creates 244 building lots and 306 units, with 178 single-family lots, 35 villa (townhouse) lots and 31 village square lots capable of supporting 93 units in three stories. The uses in the village square lots are intended for multiple uses and can vary, depending on the market, with retail or offices generally on the first floor, and office or residential uses on the upper floors. The total yield is 244 lots, yet the total disturbed footprint is 64.0 acres (or 33.9% of the total site as compared to 53.7% in Conventional and 25.9% in the Community Preserve). Density across the entire parcel is higher at 1.3 lots per acre (compared to 0.7 dwelling units per total acre). A buffer from the adjacent interstate is shown at 250', and a wetland buffer of 50' is used along the delineation line, with some vista pruning allowed. A small area in the southeast corner of the property is completely preserved. This plan illustrates, in comparison to the Community Preserve and Conventional plan, how a higher density development can lessen impacts on the environment.

The Village plan creates a hierarchy of lot sizes that is based on setbacks. The largest lots are located along the perimeter of the property and lot sizes decrease as one moves toward the village center. The lots around the perimeter are about equal in size to those in the Community Preserve; while those near the village center are 1/10 of the conventional lots. However, market research suggests that those small lots near the village center can be expected to sell for at least 80% of the conventional lots.

Lot Sizes, Setbacks and Sales Price				
Lot Yield	Size	Average SF	Setback	Sales Price
Community Preserve	70' x 125'	8,750	40'	$ 55,000
Conventional Residential	100' x 275'	27,500	70'	$ 50,000
Average Lot Residential	75' x 200'	15,000	20'	$ 47,500
Village Lot Residential	50' x 120'	6,000	15'	$ 45,000
Village Live / Work	30' x 120'	3,600	0'	$ 42,000
Village Square Lot	30' x 70'	2,100	0'	$ 40,000

Table 2.4: Lot Sizes, Setbacks, and Sales Prices for the Tupelo Tract

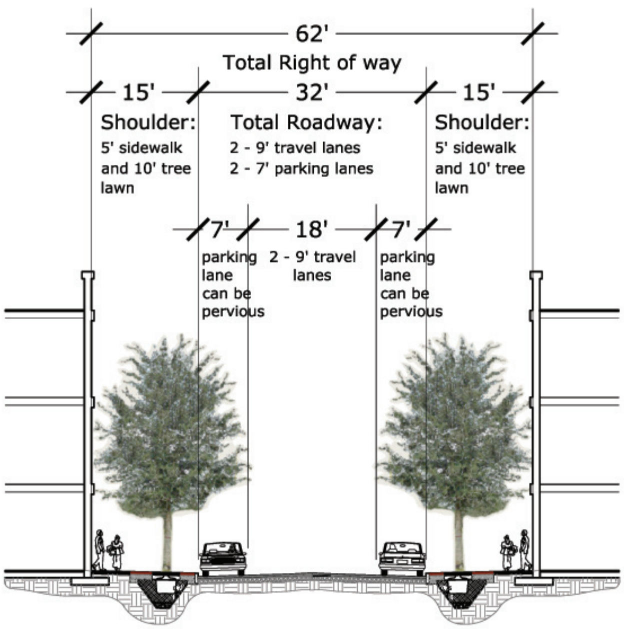
In the Village plan, houses are much closer to the street to allow front porches to be near the sidewalk. Driveways are much shorter and are no more than 40’ x 10’ for 400 square feet of driveway (half of the driveway may be in the back of the lot off of an alley). Rooftop area for the house and an outbuilding is much smaller since the village houses are all two story. Total average on-lot impervious is 1,840 square feet per lot (compared to 3,150sf per lot for the Community Preserve and 3,400sf per lot for the Conventional Plan). (Figure 2.6.2.3.a)



Typical Lot Development - Village

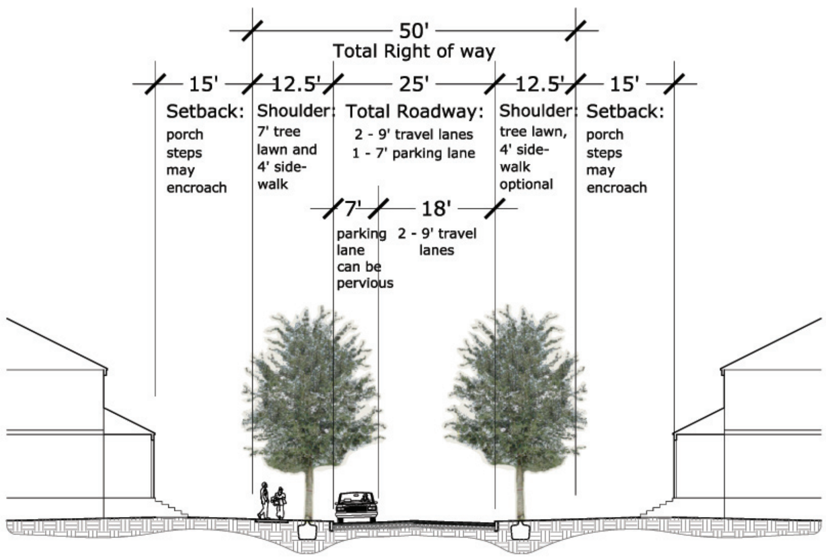
Figure 2.6.2.3.a - nts Matthew R. Baker, ASLA

The Village’s street layout is unique in that it creates a hierarchy of street widths. The streets around the Village Center are the widest (32’) and are called urban streets, since they have sidewalks and on-street parking on both sides. Moving away from the Village Center are neighborhood streets using the standard 24’ width with sidewalk and parking on one side. The outer areas of the Village use narrower streets (18’) like those in the Community Preserve. These are called local streets and have shoulders, but neither sidewalk nor curb. Finally, the alleys are the narrowest and are located between the blocks allowing access and parking in the rear of the lots. The gross length of road used in the Village plan is 13,120 linear feet (compared to 7,295 lf for the Community Preserve and 6,872 lf for conventional). The standard equivalent per lot length is 41.4 linear feet per lot (compared to 39.9 linear feet per lot for the Community Preserve and 50.9 linear feet per lot for the Conventional Plan). (Figures 2.6.2.3.b through e)



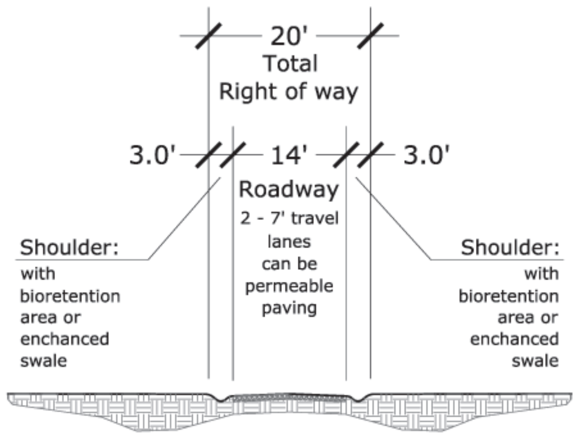
Typical Roadway Section - Urban Street

Figure 2.6.2.3.b - nts Matthew R. Baker, ASLA



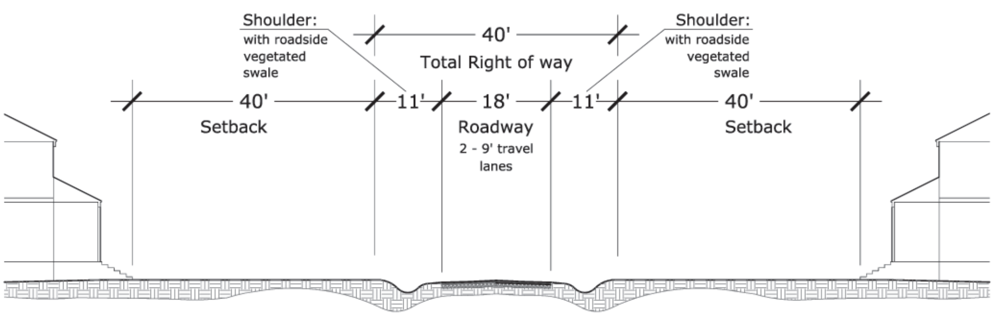
Typical Roadway Section - Neighborhood Street

Figure 2.6.2.3.c - nts Matthew R. Baker, ASLA



Typical Roadway Section - Alley

Figure 2.6.2.3.e - nts Matthew R. Baker, ASLA



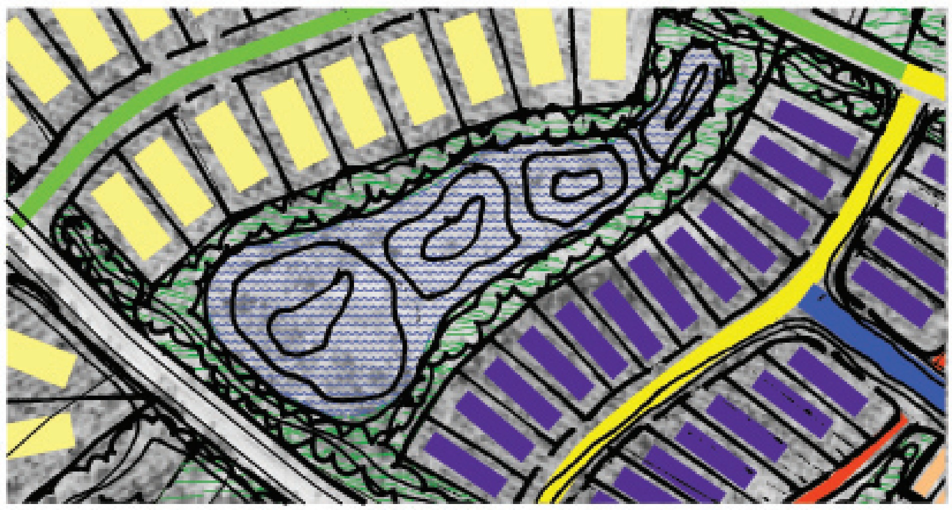
Typical Roadway Section - Local Street

Figure 2.6.2.3.d - nts Matthew R. Baker, ASLA

Street interconnections in the Village plan are frequent, allowing the residents to choose multiple routes. Two hammerhead style turnarounds are used to reduce impervious area and stormwater impacts. A small number of lots have frontage on the existing County Road 13; these are located across from the village square. Those that have one side facing County Road 13 have 50’ or more of community area as a side buffer. Trails are routed through the preserved area and are intended to interconnect with the regional trails.

Total post-development runoff from the Village plan is in the middle of the three development examples. Using the rational method, applying the appropriate cover factors as above, the total runoff from all upland areas is 237.8 cfs or 86% of the total runoff for conventional. More roadway area generates higher runoff values from streets and sidewalks; this plan generates 51.7 cfs of roadway runoff (22% of total), though on-lot impervious remains the largest generator of runoff at 74.3 cfs (or 31% of total runoff). On a per lot basis, though, total runoff for the village is the lowest at 1.0 cfs per lot (compared to 2.1 cfs for Conventional and 1.4 cfs for Community Preserve).

Given the greater intensity of development, stormwater practices for the village use more sophisticated methods for preserving water quality. A multiple cells pond (Figure 2.6.2.3.f), arguably the most effective stormwater treatment system, is created



Multiple Cells Pond - Plan

Figure 2.6.2.3.f - nts

in the natural depression of the site to the west of the Village Center. Northwest from the village center is a pocket wetland sized to treat runoff from that quadrant of the site. Alleys can be made pervious to reduce runoff volume. Along the alley edges, bioretention areas and enhanced swales can be created to capture and pre-treat runoff from the backs of lots. On the southern edge of the village center, a large bioretention area is shown, treating runoff from the urban streets and the village green. Roadside shoulders and grassed swales along the local roads can provide pre-treatment for the multiple cells pond. For those lots backing up to the wetland, bioretention areas and infiltration trenches can be used on-lot and within the 50' wetland buffer using the buffer stacking technique discussed earlier.

Other practices can further reduce runoff volume and improve water quality. These are not shown on the plan nor are their effects calculated in the runoff numbers. Such runoff-reducing practices include green roofs on the buildings, especially those on the Village Square lots, which will help mitigate the urban heat island effect, save energy within the buildings, and improve the runoff quality. Using permeable paving in the on-street parking lane will help separate the travel lane from the parking and improve runoff conditions. (See Chapter 3.) (Figure 2.6.2.3.g)

Figure 2.6.2.3g Village Square

Photo Courtesy of: Mathew R. Baker

2.7 Revenue and Cost Analysis

The revenues and costs of developing the Community Preserve, the Village, and the conventional subdivisions are compared below in Tables 2.8-2.11. The comparison indicates cost benefits for the Community Preserve because it is density-neutral and has low infrastructure costs. Likewise, the Village yields similar cost benefits compared to conventional development, but requires higher initial capital expense for infrastructure in order to produce a higher number of lots and units. The costs of acquiring and developing the subject tract under of each of these three design plans and the resulting profits from each are detailed comparatively in the *Environmental and Economic Benefits Analysis* Table(s) 2.8 through 2.11.

ENVIRONMENTAL & ECONOMIC BENEFITS ANALYSIS

SITE SUMMARY **Table 2.8**

Development Type	Conventional		Community Preserve		Village	
Area Summary	Acres	% of Total	Acres	% of Total	Acres	% of Total
Total Upland Area	123.9	65.7%	123.9	65.7%	123.9	65.7%
Total Wetland Area	64.7	34.3%	64.7	34.3%	64.7	34.3%
Total Site Area	188.6	100.0%	188.6	100.0%	188.6	100.0%
Area Use Summary	Acres	% of Total	Acres	% of Total	Acres	% of Total
Gray Space						
On-Lot Impervious	10.5	5.6%	9.8	5.2%	10.3	5.5%
Roads	4.6	2.4%	3.0	1.6%	7.2	3.8%
Right-of-Ways	7.9	4.2%	8.4	4.4%	14.1	7.5%
Green Space						
On-Lot Wooded Area	27.2	14.4%	9.3	4.9%	9.3	4.9%
On-Lot Lawn	46.1	24.4%	8.1	4.3%	18.3	9.7%
Common Area	22.6	12.0%	75.0	39.8%	59.9	31.8%
Wetland Conservation Area	64.7	34.3%	64.7	34.3%	64.7	34.3%
Total Gray Area	23.0	12.2%	21.2	11.2%	31.6	16.7%
Total Wooded Area	114.5	60.7%	149.0	79.0%	133.9	71.0%
Total Disturbed Footprint	101.3	53.7%	48.9	25.9%	64.0	33.9%
Lot Yield Summary	135	Lots	135	Lots	244	Lots
Density	135	Units	135	Units	306	Units
Gross on Site	0.7	Lots / acre	0.7	Lots / acre	1.3	Lots / acre
Net of Total Upland	1.1	Lots / acre	1.1	Lots / acre	2.0	Lots / acre
Imperious Area	Acres	% of Total	Acres	% of Total	Acres	% of Total
Total Impervious Area	15.1		12.8		17.5	
% Impervious Area / Total Area	8%		7%		9%	
Total Impervious Per Lot	4,869	SF	4,125	SF	3,118	SF
Per Lot Imp. Saving compared to	-	SF	744	SF	1,751	SF
RUNOFF	Rainfall Intensity		7.6 in /hr (I) (Note 1)			
Runoff Coefficient (C)	Acres (A)	Runoff (Q)	Acres (A)	Runoff (Q)	Acres (A)	Runoff (Q)
↓ cfs = cubic feet per second						
0.12 **Predevelopment Runoff**	123.9	113.0 cfs	123.9	113.0 cfs	123.9	113.0 cfs
Gray Space						
0.95 On-Lot Impervious	10.5	75.9 cfs	9.8	70.5 cfs	10.3	74.3 cfs
0.95 Roads	4.6	33.0 cfs	3.0	21.8 cfs	7.2	51.7 cfs
Green Space	-	0.0 cfs	-	0.0 cfs	-	0.0 cfs
0.12 On-Lot Wooded Area	27.2	24.8 cfs	9.3	8.5 cfs	9.3	8.5 cfs
0.35 On-Lot Lawn	46.1	122.6 cfs	8.1	21.4 cfs	18.3	48.7 cfs
0.12 Common Area	22.6	20.6 cfs	75.0	68.4 cfs	59.9	54.6 cfs
0.35 Right-of-Way Lawn	3.3	8.8 cfs	5.4	14.2 cfs	6.9	18.4 cfs
Predevelopment Runoff (cfs)		113.0 cfs		113.0 cfs		113.0 cfs
Post-Development Runoff (cfs)		277.0 cfs		190.6 cfs		237.8 cfs
% of Conventional		100%		69%		86%
Runoff per lot (cfs)		2.1 cfs		1.4 cfs		1.0 cfs
per lot % of Conventional		100%		69%		48%
Runoff per unit (cfs)		2.1 cfs		1.4 cfs		0.8 cfs
per unit % of Conventional		100%		69%		38%

Note 1: Design Storm is the average of the Savannah & Brunswick 10-year return, 5-minute time of concentration storms, rounded.

Green Growth Guidelines a Low Impact Development Strategy for Coastal Georgia

ENVIRONMENTAL & ECONOMIC BENEFITS ANALYSIS

SITE DATA **Table 2.9**

Development Type		**Conventional**		**Community Preserve**		**Village**	
Lot Yield	Size	No. of Lots	% of Total	No. of Lots	% of Total	No. of Lots	% of Total
Community Preserve	70' x 125'	-	0.0%	135	100.0%	-	0.0%
Conventional Residential	100' x 275'	130	96.3%	-	0.0%	-	0.0%
Average Lot Residential	75' x 200'	5	3.7%	-	0.0%	44	18.0%
Village Lot Residential	50' x 120'	-	0.0%	-	0.0%	134	54.9%
Village Live / Work	30' x 120'	-	0.0%	-	0.0%	31	12.7%
Village Square Lot	30' x 70'	-	0.0%	-	0.0%	35	14.3%
Total Lots		135	100.0%	135	100.0%	244	100.0%
		135	Units	135	Units	306	Units
Lot Size Summary	Average SF	No. of Lots	Acres	No. of Lots	Acres	No. of Lots	Acres
Community Preserve	8,750	-	-	135	27.1	-	-
Conventional Residential	27,500	130	82.1	-	-	-	-
Average Lot Residential	15,000	5	1.7	-	-	44	15.2
Village Lot Residential	6,000	-	-	-	-	134	18.5
Village Live / Work	3,600	-	-	-	-	31	2.6
Village Square Lot	2,100	-	-	-	-	35	1.7
Total Lot Size		135	83.8	135	27.1	244	37.9
On-Lot Impervious Summary	Footprint Average SF	% of Lot	Total SF	% of Lot	Total SF	% of Lot	Total SF
Community Preserve	3,150	36%	-	36%	425,250	36%	-
Conventional Residential	3,400	12%	442,000	12%	-	12%	-
Average Lot Residential	3,200	21%	16,000	21%	-	21%	140,800
Village Lot Residential	1,600	27%	-	27%	-	27%	214,400
Village Live / Work	1,600	44%	-	44%	-	44%	49,600
Village Square Lot	1,250	60%	-	60%	-	60%	43,750
Total On-Lot Impervious By SF			458,000		425,250		448,550
By Acres			10.5		9.8		10.3
On-Lot Wooded Summary	Average SF	% of Lot	Total SF	% of Lot	Total SF	% of Lot	Total SF
Community Preserve	3,000	34%	-	34%	405,000	34%	-
Conventional Residential	9,000	33%	1,170,000	33%	-	33%	-
Average Lot Residential	2,800	19%	14,000	19%	-	19%	123,200
Village Lot Residential	2,000	33%	-	33%	-	33%	268,000
Village Live / Work	400	11%	-	11%	-	11%	12,400
Village Square Lot	-	0%	-	0%	-	0%	-
Total Lot Greenspace By SF			1,184,000		405,000		403,600
By Acres			27.2		9.3		9.3
On-Lot Lawn Summary	Average SF	No. of Lots	Total SF	No. of Lots	Total SF	No. of Lots	Total SF
Community Preserve	2,600	-	-	135	351,000	-	-
Conventional Residential	15,100	130	1,963,000	-	-	-	-
Average Lot Residential	9,000	5	45,000	-	-	44	396,000
Village Lot Residential	2,400						321,600
Village Live / Work	1,600	-		-	-	31	49,600
Village Square Lot	850	-		-	-	35	29,750
Total Lot Greenspace By SF		135	2,008,000	135	351,000	110	796,950
By Acres			46.1		8.1		18.3

Green Growth Guidelines a Low Impact Development Strategy for Coastal Georgia

ENVIRONMENTAL & ECONOMIC BENEFITS ANALYSIS

INFRASTRUCTURE **Table 2.10**

Development Type		Conventional		Community Preserve		Village	
Impervious Area	Impervious		Impervious		Impervious		Impervious
Streets and Sidewalks	Width	Linear Feet	Area	Linear Feet	Area	Linear Feet	Area
Urban Street (Sidewalk & Parking Both Sides)	42.00	-	-	-	-	2,360	99,120
Neighborhood Street (Sidewalk & Parking One Side)	29.00	6,872	199,288	-	-	2,840	82,360
Local Street (Narrower, Shoulder, no curb)	18.00	-	-	7,295	131,310	4,950	89,100
Alley (Model assumes impervious, consider pervious)	14.00	-	-	-	-	2,970	41,580
Total Roadway Impervious Area		6,872	199,288	7,295	131,310	13,120	312,160
By Acres			4.6		3.0		7.2
Street Widths & Area	Width	Linear Feet	Area	Linear Feet	Area	Linear Feet	Area
Urban Street (Sidewalk & Parking Both Sides)	32.00	-	-	-	-	2,360	75,520
Neighborhood Street (Sidewalk & Parking One Side)	24.00	6,872	164,928	-	-	2,840	68,160
Local Street (Narrower, Shoulder, no curb)	18.00	-	-	7,295	131,310	4,950	89,100
Alley (Model assumes impervious, consider pervious)	14.00	-	-	-	-	2,970	41,580
Total Actual Roadway		6,872	164,928	7,295	131,310	13,120	274,360
By Acres			3.8		3.0		6.3
Right-of-Way (R/W)	R/W Width	Linear Feet	Area	Linear Feet	Area	Linear Feet	Area
Urban Street (Sidewalk & Parking Both Sides)	70.00	-	-	-	-	2,360	165,200
Neighborhood Street (Sidewalk & Parking One Side)	50.00	6,872	343,600	-	-	2,840	142,000
Local Street (Narrower, Shoulder, no curb)	50.00	-	-	7,295	364,750	4,950	247,500
Alley (Model assumes impervious, consider pervious)	20.00	-	-	-	-	2,970	59,400
Total Right-of-Way		6,872	343,600	7,295	364,750	13,120	614,100
By Acres			7.9		8.4		14.1
	SE	Actual	SE	Actual	SE	Actual	SE
Total 24' Standard Equivalent (SE)	Factor	Linear Feet	Linear Feet	Linear Feet	Linear Feet	Linear Feet	Linear Feet
Urban Street (Sidewalk & Parking Both Sides)	1.3	-	-	-	-	2,360	3,068
Neighborhood Street (Sidewalk & Parking One Side)	1	6,872	6,872	-	-	2,840	2,840
Local Street (Narrower, Shoulder, no curb)	0.75	-	-	7,295	5,471	4,950	3,713
Alley (Model assumes impervious, consider pervious)	0.25	-	-	-	-	2,970	743
Total		6,872	6,872	7,295	5,471	13,120	10,363
# of Actual LF / 24' SE		100.0%		75.0%		79.0%	
Actual Linear Feet		6,872		7,295		13,120	
Standard Equivalent Linear Feet		6,872		5,471		10,363	
per lot Actual Linear Feet		50.9		54.0		53.8	
per lot Standard Equivalent Linear Feet		50.9		40.5		42.5	
per unit Actual Linear Feet		50.9		54.0		42.9	
per unit Standard Equivalent Linear Feet		50.9		40.5		33.9	
		Cost Per Linear Foot (LF) is based on Standard Equivalent (SE)					
COST ANALYSIS		Cost Per LF	Total Cost	Cost Per LF	Total Cost	Cost Per LF	Total Cost
Hard Costs							
Roadways		$ 50.00	$ 343,600	$ 30.00	$ 164,138	$ 60.00	$ 621,780
Excavation / Grading Cost		10.00	$ 68,720	10.00	$ 54,713	10.00	$ 103,630
Sewer / Water / Drainage		50.00	$ 343,600	40.00	$ 218,850	50.00	$ 518,150
Landscaping / Irrigation		25.00	$ 171,800	20.00	$ 109,425	35.00	$ 362,705
	Subtotal hard costs	$ 135.00	$ 927,720	$ 100.00	$ 547,125	$ 155.00	$ 1,606,265
Soft Costs							
Design/ Engineering (fees by lot)		1,000.00	$ 135,000	1,000.00	$ 135,000	1,000.00	$ 244,000
Impact Fees (fees by unit)		2,500.00	$ 337,500	2,500.00	$ 337,500	2,500.00	$ 765,000
	Subtotal hard costs	$ 3,500.00	$ 472,500	$ 3,500.00	$ 472,500	$ 3,500.00	$ 1,009,000
Total Cost with Impact Fees			$1,400,220		$1,019,625		$ 2,615,265
Average Cost Per Building Lot with Impact Fees			$10,372.00		$ 7,552.78		$ 8,546.62
Total Cost without Impact Fees			$1,062,720		$ 682,125		$ 1,850,265
Average Cost Per Building Lot without Impact Fees			$ 7,872.00		$ 5,052.78		$ 6,046.62

Green Growth Guidelines a Low Impact Development Strategy for Coastal Georgia

ENVIRONMENTAL & ECONOMIC BENEFITS ANALYSIS

Projected Gross Profit & Tax Revenue **Table 2.11**

Development Type			**Conventional**			**Community Preserve**			**Village**		
Description	Size	Price/Cost Per SF	# of Lots	Price/Cost Per Lot	Total	# of Lots	Price/Cost Per Lot	Total	# of Lots	Price/Cost Per Lot	Total
Lot Sales											
Community Preserve	8,750	$ 6.29	-	$ 55,000	-	135	$ 55,000	7,425,000	-	$ 55,000	-
Conventional Residential	22,000	$ 2.27	130	$ 50,000	6,500,000	-	$ 50,000	-	-	$ 50,000	-
Average Lot Residential	11,250	$ 4.22	5	$ 47,500	237,500	-	$ 47,500	-	44	$ 47,500	2,090,000
Village Lot Residential	6,000	$ 7.50	-	$ 45,000	-	-	$ 45,000	-	134	$ 45,000	6,030,000
Village Live / Work	3,600	$ 11.67	-	$ 42,000	-	-	$ 42,000	-	31	$ 42,000	1,302,000
Village Square Lot	2,100	$ 19.05	-	$ 40,000	-	-	$ 40,000	-	35	$ 40,000	1,400,000
Gross Lot Sales			135	49,907	$6,737,500	135	55,000	$7,425,000	244	44,352	$10,822,000
Acquisition Cost				21,481	2,900,000		21,481	2,900,000		11,885	2,900,000
Site Infrastructure Cost				7,872	1,062,720		5,053	682,125		7,583	1,850,265
Total Direct A & D Expense				$ 29,353	$3,962,720		$ 26,534	3,582,125		$ 19,468	$4,750,265
Impact Fees				$ 2,500	$ 337,500		$ 2,500	$ 337,500		$ 2,500	$ 765,000
Total Direct A & D Expense with Impact Fees				$ 31,853	$4,300,220		$ 29,034	3,919,625		$ 21,968	$5,515,265
Gross Profit without Impact Fees				**$20,554**	**$2,774,780**		**$28,466**	**$3,842,875**		**$24,884**	**$6,071,735**
Gross Profit Margin without Impact Fees				41.2%			51.8%			56.1%	
Gross Profit with Impact Fees				**$18,054**	**$2,437,280**		**$25,966**	**$3,505,375**		**$22,384**	**$5,306,735**
Gross Profit Margin with Impact Fees				36.2%			47.2%			50.5%	
Property Valuation					$6,737,500			$7,425,000			$10,822,000
Assessed Value					2,695,000			2,970,000			4,328,800
Annual Tax Revenue					**$ 281,089**			**$ 309,771**			**$ 451,494**
% of Conventional					100.0%			110.2%			160.6%

Green Growth Guidelines a Low Impact Development Strategy for Coastal Georgia

2.7.1 Site Acquisition Cost

The cost of acquisition assumes acquisition price per acre, rounded to include anticipated closing cost such as surveying, legal fees, and title insurance and then multiplied by the number of acres in the subject site. The acquisition amount per acre was generated from Whitley, Leggett, & Associates, a local, Georgia certified, appraisal firm and based on the sales of five residential subdivision tracts in the western Chatham County, Georgia area. The comparable data indicated prices per usable acre ranged from a low of $16,519 to a high of $26,793, making the average purchase price per acre for the Tupelo Tract $20,139. The five purchases occurred over the period December 2002 to March 2004. All the parcels were fully wooded at the time of acquisition, with three of the five located partially in flood zones, one entirely in a flood zone and one entirely upland. All of the tracts were zoned to allow use as a residential subdivision, with four of the five designated Planned Urban Developments (PUD) permitting limited multi-family and commercial use. The cost of acquisition is shown as the same amount in all three cases, primarily because the intended use of the property is the same for all three cases with little influence on price due to the actual design of the planned residential subdivision.

2.7.2 Roadway Cost

The size, length, and width of roadways and lots, with consideration for disturbed footprints and the drainage system of each lot, were calculated and detailed in *Environmental and Economic Benefits Analysis* Table 2.10, *Infrastructure*. The following table is a summary showing projected size, length and width for the roadway system for each site development plan facilitating comparison of the amounts found in both alternative design plans with the conventional 24' standard equivalent:

Roadways	Conventional	Preserve	Village
# of Actual LF / 24' SE	100%	75%	79%
Actual Linear Feet	6,872	7,295	13,120
24' SE / Linear Feet	6,872	5,471	10,363

Table 2.5: Roadway Area Comparison for the Tupelo Tract

The conventional plan road system is 6,872 linear feet of neighborhood streets with parking on one side. The Community Preserve roadway takes approximately 18% less 24' SE/linear foot than the conventional plan primary due to its use of narrow and curbless local streets. The Village requires approximately 30% more 24' SE/linear foot than the conventional plan, due primarily to its use of urban streets with sidewalks and parking on both sides. Based on data provided by EMC Engineering Services, Inc. in Savannah, Georgia, the Community Preserve roadway system is the least expensive to construct at approximately $30.00 per linear foot, nearly $20.00 per linear foot less than the conventional plan road system. The additional width and consequential area required for use of 2,360 linear feet of urban streets in the Village pushed the cost of this road system to approximately $60.00 per linear foot or $10.00 more per linear foot than the conventional plan. However, the Village roadway system supports 306 housing units compared to 135 in the conventional plan. Simply put, the higher cost of the Village road system is offset by higher lot and unit yield.

2.7.3 Site Infrastructure Cost

Site infrastructure cost represents projected expense related to constructing roadways, site grading, construction of sewer and water/drainage systems, landscaping and irrigation, and impact and design/engineering fees. These are estimated based on standards within the local area. Adding up the market cost of these resources, such as supplying sewer and water (labor, material, natural resources), are shown comparatively in the following:

Infrastructure	Conventional		Preserve		Village	
Cost per	LF	Total	LF	Total	LF	Total
Roadways	50.00	330,681	30.00	164,138	60.00	621,780
Excavation/Grading	10.00	68,720	10.00	54,713	10.00	103,630
Sewer / Water / Drainage	50.00	343,600	40.00	218,850	50.00	518,150
Landscaping / Irrigation	25.00	171,800	20.00	109,425	35.00	362,705
Engineering / Impact Fees		472,500		472,500		1,009,000
Total Infrastructure Cost		1,400,220		1,019,625		2,615,265
Infrastructure Cost per Lot		**$10,372**		**$7,553**		**$8,547**

Table 2.6: Infrastructure Cost Breakdown for the Tupelo Tract

Grading cost for all three plans is estimated at approximately $10 per square foot, with the Village plan requiring the greatest expenditure due to its increased area for roadway. The Community Preserve's use of less area for roadways resulted in an approximate 20% savings in grading cost compared to the conventional plan.

These same results are seen again in the cost of implementing sewer/water/drainage and landscaping/irrigation, with a downward adjustment ($50 to $40 per linear foot) made to the cost of sewer/water/drainage for the Community Preserve due to use of local streets without curbs and upward ($25 to $35 per linear foot) to the cost of landscape/irrigation in the Village due to its greater use of area.

2.7.4 Cost Conclusion

Overall, the cost of providing these resources in the Conventional Plan totaled $10,372 per lot compared to $7,553 per lot in the Community Preserve development plan and $8,547 per lot in the Village plan. In this example, both the Community Preserve and the Village cost less to develop than the conventional subdivision.

2.7.5 Revenue and Profit Analysis

Cases throughout the country show that there is a great demand for residential lots abutting open space (especially trails and greenways), such that they are often valued higher than lots with no adjacent open space and appreciate faster in value over time than lots in a conventionally-designed subdivision. Market surveys indicate strong consumer demand (faster absorption rate) for density-neutral development alternatives like the Community Preserve plan or even higher density developments like the Village where open or green space and use of low impact development stormwater drainage solutions are implemented. Further, sale results of residential and non-residential lots in similar developments indicate smaller lots bordering green space appreciate faster in value than larger lots with backyard views into other homes.

Market value(s) for the improved lots for each development plan were determined from sale comparables provided by Whitley, Leggett & Associates. The sales prices of 137 improved lots sold from 1998 to the present in four subdivisions in western Chatham County, Georgia were surveyed and compared. The lots were equal in size, dimension, and accessibility to those created and used in the Tupelo Tract. Two of the comparable subdivisions were conventional, while one could be considered community preserve and one a village. In the case of the village and community preserve comparables, lots sales were as high as $120,000 per lot, while the range of lot prices within the conventional subdivisions were from $42,000 to $57,000. The model reflects a conservative estimate of value per lot based on size. For comparative purposes, lots of similar sizes have equal value regardless of where they are located within the subdivision. In reality, location of the lot plays a determining role in the price of the lot.

Once these values were determined, the tax milleage rate applicable to Chatham County, Georgia was applied to the tax assessable portion of each lot's market value. Gross market value or gross lot sales are net of any sales or marketing commissions.

	Conventional	Preserve	Village
No. of Residential Lots	135	135	244
Gross Market Value/Sales	$6,737,500	$7,425,000	$10,822,000
Gross Profit	$2,437,280	$3,842,875	$6,071,735
Profit Margin	41.2%	51.8%	56.1%
Property Valuation (Sold Out)	6,737,500	7,425,000	10,822,000
Potential Annual Tax Revenue	281,089	309,771	451,494

Table 2.7: Revenue, Profit, and Tax Value Breakdown for the Tupelo Tract

Gross Revenue or Market Value is the multiplication of the amounts of various types of lots by the market value for the respective type of lot as established by the market survey. This straight-line approach ignores absorption pace and lot value appreciation over time, both factors driven by external influences (such as consumer mortgage interest rates and local unemployment trends) not necessarily vital to comparing the discounted cash flow value of the Conventional Plan to the Community Preserve or Village. Indeed, the straight-line approach in this model assumes all values remain the same over an equal sell-out or absorption period for all three models. While the horizon is key to determining the actual internal rate of return, in this case it is more important that the models are compared on an equal basis without regard for differentiation in the absorption period. In actuality, research has shown both the Village and Community Preserve are currently experiencing greater absorption due to increased consumer demand. The results indicate both the Village and Community Preserve would yield greater gross revenue over an equal period of time than the Conventional Plan. The Village generates the greater value, due to its higher number of lots and housing units.

Gross profit is the gross value of individual lot sales less the direct cost of acquisition and site infrastructure development. Marketing, fixed expense (taxes, insurance), and operational overhead are not included in this model and would be subtracted from the gross profit to determine entrepreneurial profit. The greatest gross profit margin (calculated by dividing gross profit by gross sales) was achieved in the Village, at 56.1%. Community Preserve lot sales yielded a 51.8% profit margin. Lot sales in the Conventional subdivision averaged a 41.2% profit margin, indicative of lower gross lot sales and higher infrastructure cost compared to the Community Preserve and the Village.

While there is a greater gross profit potential in the Village, there is also greater gross infrastructure cost due to the higher number of serviceable lots. The Village gross profit can be increased further if calculated by the number of sellable units rather than sellable lots, as the Village calls for 306 total housing units on 244 lots. Potential commercial development also improves the gross profit in both the Community Preserve and Village, but is not compared here, as the Conventional plan does not have space for commercial development.

2.7.6 Revenue and Profit Conclusion

The Community Preserve is a viable alternative to conventional development yielding an equal number of lots while costing less to construct and generating better than conventional profit margins. It is also a design that can be employed in most of coastal Georgia immediately, due to its similarity to conventional design. The Village mixed-use plan generates more lots/housing units and a higher profit than the Conventional plan. Both the Village and Community Preserve are better site designs than the Conventional subdivision, due to the lower cost to construct and the added premium found in these forms of development – directly attributable to the ecological and social benefits of their design and consumer demand for these amenities.

2.7.7 Tax Considerations

When a residential development is built outside of a community, it requires roads, sewer systems and water lines to be built and brought to the development by the local governing authority. Eventually, schools and emergency services also become necessary. The cost of these is rarely returned by the collection of property taxes, in other words, most residential developments fall short of yielding sufficient tax revenue to pay for the municipal services required initially and over-time. The Village development plan, however, is likely to generate tax revenue annually in an amount sufficient to pay for its annual operation and maintenance simply because of its higher density and consequential tax assessable valuation. While this may appear negative to the consumer on the surface, in reality the greater value and subsequent property tax revenue is allocated to a larger number of users in the same space, facilitating affordability.

2.8 Economic Benefits

Understanding the cost differences and profit potential among development styles is an evaluation tool for both local governments and land developers. Growing interest in sustainable development requires a comparative framework, including cost and profit considerations. This is especially true when considering historic trends and future projections for population growth, job growth, housing, family size and household income in the coastal areas of southeast Georgia.

Continuing the existing, conventional practice of site development – whether creating from existing green space or from within existing urban areas – will continuously result in expensive initial investments plus high maintenance costs almost entirely borne by the public or the developer. The best solution to the problem is the Greeth Growth Guidelines.

The non-conventional site designs shown in this guide reflect the following general economic benefits over conventional site design:

- Higher lot yield (Village),
- Higher lot sales price (Community Preserve and Village),
- Higher lot tax value (Community Preserve and Village),
- Lower infrastructure cost per lot (Community Preserve and Village),
- Enhanced marketability (Community Preserve and Village), and
- Added amenities (Community Preserve and Village).

2.9 Social Benefits

In addition to environmental and economic benefits, residents living within developed areas using green growth techniques receive a variety of social benefits including:

- A development with a "sense of community",
- Convenience of a short travel to basic services,
- Recreation, both passive and active, with added green and open space,
- Communities that are more social, more connected with "nature", and
- Greater opportunities for biking and walking.

Understanding the interaction between the physical layout and the social aspects of a place is what makes it possible to go from a mere development to a real neighborhood. Moving the buildings closer to the street provides a chance for social interaction with one's neighbors. (Figure 2.9.a) Knowing one's neighbors allows for the possibility that they will watch out for one another, will recognize when something or someone is out of place or acting in a manner that might indicate ill intent. Jane Jacobs call this awareness "eyes on the street"; the more eyes on the street, the safer the neighborhood.

Figure 2.9a Bikers Enjoy the Social Benefits of a Well Designed Community

Photo Courtesy of: Matthew R. Baker

The environmental benefits listed in the earlier section are also social benefits as well. Being free from a long commute both allows one to more time to spend with friends and family as well as limiting the air and water pollution generated from operating a vehicle. Having significant green space within walking distance provides an opportunity for nature walks, where wildlife can be observed, enriching the experience of living there. That same green space is helping to improve water and air quality.