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Implementation of Low Impact Development in Modern Urbanization as Exampled Through Capstone Design

Honors Thesis: IDH 5975

Author:
Allyson G. Risner
U-80175725
University of South Florida
Honors College

Mentor:
Dr. Mark A. Ross, PhD, PE
University of South Florida
Department of Civil and Environmental Engineering

Semester Completed:
Spring 2009

Abstract

This thesis is a continuation of my Engineering Capstone Design. The design itself involves the site plan of a fictitious mixed-use development in Polk County, Florida. The initial design was completed as a group (consisting of five people) under the fabricated engineering firm Lever Engineering, LLC and was completed as if it would be submitted to the County for actual approval.

The project was designed over a 20 acre site (with an additional 10 acres available for purchase) in Winter Haven, Florida that is currently being used as a neighborhood park with several youth baseball fields. Lever Engineering was given specific design requirements for the site that were deemed necessary to serve the area's growing population. In the development, it was requested that the campus include a YMCA with an outdoor pool and children's athletic field, an elderly assisted living facility, multi-family housing, a child care facility with adequate play area, a library and cultural center, a public health clinic, a passive recreational park complete with forested area and picnic shelter, and a paved walking trail throughout the development. The plans must also include adequate parking, utility layout and design, roadway planning, and a complete stormwater management plan. It was also asked that the development be an integrated site plan with the various components organized and situated in a logical and aesthetic manner, while providing preservation of existing trees and other amenities where practical.

Using the design developed, I have made recommendations to the "County" to develop this new neighborhood utilizing Low Impact Development (LID) technologies and practices. The LID proposal focuses on mimicking the natural hydrologic cycle of the area in an attempt to reduce environmental impact of development. Means of implementation include Bioretention swales, pervious pavements, and the strategized use of canopy trees. Each of these elements help stormwater to permeate into the soil as it normally would without development and reduce runoff.

The enclosed engineering report completed by Lever Engineering includes the feasibility research of the above project, the site plan (including structural layout, utilities, roadway and parking design, grading details, and an integrated stormwater management plan), required permits, and a cost estimate. Also included within the report are reasons, means, estimated additional cost, and application of incorporating the recommended Low Impact Development technologies into the site.

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Acknowledgements

I would like to thank those who assisted me in both the research and the design process involved in creating this thesis. The contributions made by these individuals helped make this report a success.

Capstone Group:
- Tyler McDougal
- Tracy Dayton
- Zachary Gross
- Patrick Beck

Committee Members:
- Dr. Mark Ross
- Jennifer Perone

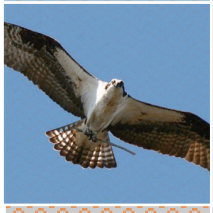
Capstone Director:
- Mr. George Wise

2009

LEVER ENGINEERING, LLC.

GIVE ME A PLACE TO STAND AND I WILL MOVE THE EARTH

-A remark of Archimedes quoted by Pappus of Alexandria-



Final Engineering Details

Osprey Village Development Project

Submitted To:

Polk County, FL
C/O Dr. Mark Ross, PhD, PE
University of South Florida
Department of Civil and Environmental Engineering
4202 East Fowler Avenue, ENB 118
Tampa, FL 33620-5350

In Response To:

Fictitious Multi-Use Neighborhood Project
Request for Proposal
Engineering Design Competition

Submitted By:

Lever Engineering, LLC.

Date:

April 20, 2009

Executive Summary

In order to serve the growing need for social services Polk County (COUNTY) is developing a new multi-functional community (Osprey Village). The COUNTY has designated a 20.28 acre tract of land for Osprey Village. This land is located at 50 Coleman Rd. Winter Haven FL 33880. This property is currently used as a public park and recreation area that contains four little league baseball fields, three racquetball courts, a basketball court, a concession stand, and other ancillary support structures. The COUNTY also provided the developer with the option of acquiring an additional 10 acre tract of land that lies due east of the 20 acre tract of land. Due to the cost of acquiring the additional 10 acre tract of land, Lever Engineering has designed Osprey Village in an aesthetically pleasing and efficient manner utilizing only the 20 acre tract of land. The COUNTY has designated that Osprey Village contain the components shown in Table 1 and that each component be designed to meet the constraints shown below as well as minimize the impact on surrounding property.

Component	Area(ft^2)	Units	Constraints
YMCA	10,000	—	—
Pool	5,000	—	—
Athletic Field	—	—	—
Multi-Family Housing	—	80	2 Story Max.
Assisted Living Facility	—	120	3 Story Max.
Child Care Facility	10,000	—	—
Library & Cultural Center	20,000	—	—
Public Health Clinic	14,000	—	—
Passive Recreation Area	—	—	—
Pavilion	4,000	—	—
Walking Trail	—	—	—

Table 1: Development Requirements

In order to develop the site it is necessary for the COUNTY to rezone the property from a designation of Recreation Open Space (ROS) to a designation of Residential Medium (RM). Lever Engineering has planned Osprey Village as a Residentially Based Mixed Development (RBMD) and using innovative design practices achieved the necessary points required by the Polk County Land Development Code Book to raise the Residential Gross Density allowances to the level required by Osprey Village.

In order to manage the increased stormwater flow created by buildings, roadways, and other impervious surfaces throughout the development, Lever Engineering has designed a 3.83 acre wet detention pond to be located in the eastern section of the property. The increased stormwater flow is routed from buildings, roadways, and parking lots to this pond via a reinforced concrete pipe system ranging in size from 18 – 42 inches. Lever Engineering feels that this pond will not only provide adequate stormwater management, but will also create an aesthetically pleasing accent for both residents and visitors of Osprey Village.

To provide potable water to the site, Osprey Village will connect to the existing water main along Coleman Road's right-of-way. The potable water system is designed to provide adequate water pressure and fire flow to all components within the development. The plans include four fire hydrants and pipes are blue Polyvinyl Chloride (PVC) ranging in size from 1 – 8 inches.

The gravity sanitary sewer system on site discharges to a pump station located in the southwest quadrant of the property which conveys the flow to the existing 8 inch force main at the southwest corner of the site. The gravity sewer consists of green PVC pipe with an 8 inch collector and 6 inch leads.

The total cost for development of Osprey Village is estimated to be $2,400,000. A detailed estimate is included in **Appendix F.**

In addition, Lever Engineering has included recommendations for the development of Osprey Village in an attempt to lessen the environmental impact on the property. These recommendations are intended to follow suit with common Low Impact Development practices. Means of suggested implementation are included within the report and details are included within **Appendix H.** Also included is a detailed estimate of additional cost associated with the proposed LID technologies, which has been calculated to be approximately $300,000.

This document includes Lever Engineering's specifications and site plans for each of the aforementioned components. These elements are intended to fully inform Polk County of the design details and of all visual and technical aspects of the project as proposed by Lever Engineering, LLC.

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1.0 Project Overview

The proposed project consists of a YMCA facility with outdoor pool and children's athletic field, multi-family housing, elderly assisted living facilities, a child care facility, a library and cultural center, a public health clinic, a passive recreation area with picnic area and covered pavilion, a paved walking trail through the campus, an entrance road with interior access streets, and new parking lots with paved drive isles. A site layout map of the proposed development is in **Appendix G**.

1.1 General Site Information

1.1.1 Legal Site Description

The proposed development is located in Section 25, Township 28S, Range 25E. The parcel ID#'s of the two main properties proposed for development are:

Property 1 ID#: 252825000000024040
Property 2 ID#: 252825000000024010

Combined these two parcels cover approximately 20 acres. The property address is 50 Coleman Road, Winter Haven, FL 33880. The Polk County Property Appraiser records of the two main properties are attached in **Appendix A**.

A vicinity map of the proposed development is attached in **Appendix A.**
A site aerial map of the proposed development is attached in **Appendix A.**

1.1.2 Existing Use of Property

The property is currently a county park. The park contains four youth baseball fields, one basketball court, three racquetball courts, one concession building, bathrooms, covered picnic areas, and supporting storage and maintenance buildings.

1.1.3 Easements

The only existing easement on property is a fifty foot perpetual roadway access easement that encompasses the entrance road into the park. This easement extends along the access road for approximately 400 feet. Other

offsite easements for drainage and utilities exist that will not require alteration.

1.2 Zoning

1.2.1 Current Zoning

Property one is currently zoned as Recreation Open Space (ROS) as shown in Current Zoning Map attached in **Appendix A**. The purpose of the ROS district is to provide for the use and development of lands and areas which are accessible to the public, and which are oriented towards providing recreational activities and services for County residents and visitors. This designation severely limits the types of structures that can be built on this parcel. Properties two thru seven are currently zoned as Residential Medium (RM) as shown in Current Zoning Map (See **Appendix A**). The purpose of the RM district is to provide areas for medium density residential development within urban areas. The RM district permits single-family dwelling units, duplex units, multi-family units, group living facilities, and community Facilities. This designation permits the development of all proposed structures by Polk County for the Osprey Village Development.

1.2.2 Surrounding Parcels

The surrounding parcels are residential properties. The northern border is Coleman Road with RM beyond the road Right-of-Way. The eastern boundary is bordered by residential properties zoned RM. The southern boundary is border by residential properties zoned RM. The southwestern corner is bordered by residential property zoned Residential Low-1. The western boundary is bordered by residential properties zoned RM.

1.2.3 Zoning Recommendation

Lever Engineering recommends that Osprey Village be constructed on only the 20 acre site and developed as a Residentially Based Mixed-Use Development (RBMD). Property one should be rezoned from Recreation Open Space (ROS) to a designation of Residential Medium (RM). The County should then seek to combine properties one and two into a single parcel of land. Utilizing new and innovative engineering practices, Lever Engineering has designed Osprey Village in a clean and efficient manner

in order to achieve the necessary density points required to increase the Residential Gross Density level to the concentration required by Polk County (See **Appendix A**).

1.3 Site Access and Constraints

For the proposed site, Polk County has required that access to the campus be permitted only through existing roads. An overview of the site shows that there is currently one public paved roadway bordering the area: Coleman Road SW. Coleman Road is a two lane public highway that runs east-west along the north boundary of the site and currently serves as the only access point to the park. There are no public roadways adjoining the western, southern, or eastern perimeters.

1.4 Endangered and Protected Species

During inspection of the site, it was noted that two pairs of nesting ospreys currently inhabit the area. This is an estimate based on personal observation and a more involved investigation will provide the company with a more accurate account. The ospreys observed currently nest atop the field lighting poles that are on site. Because these poles will need to be removed during the construction process, these nests must be safely relocated. In accord with the State of Florida Fish and Wildlife Conservation Commission, a Migratory Bird Nest Removal Permit Application must be completed and submitted to the Division of Habitat and Species Conservation.

2.0 Proposed Building Specifications

2.1 Multi-Family Housing Specifications

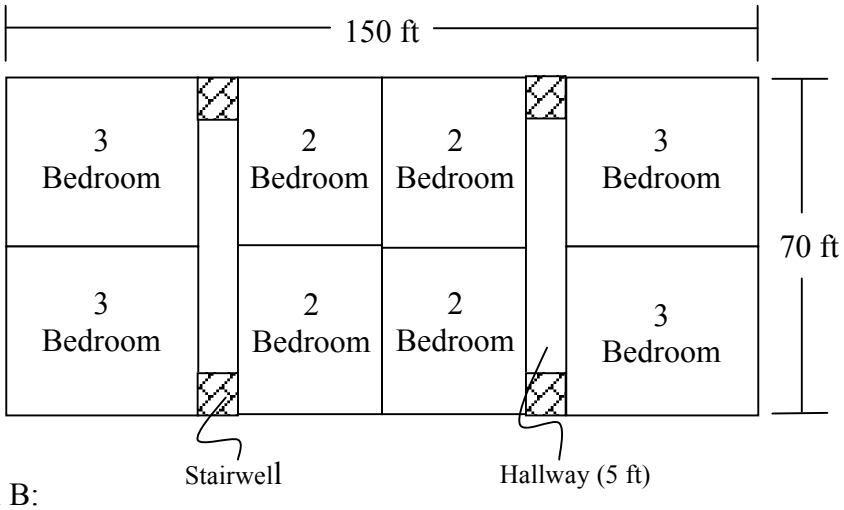
The housing complex will be located in the southern portion of the campus and will consist of five two-story buildings, each with sixteen units (eight on each floor). We will incorporate two building layouts, referred to as Model A and Model B. Of the five buildings, two will be Model A and the remaining three will be Model B. The complex will include such amenities as a leasing office and clubhouse, and a playground area.

Based on the sub-contracted work of AGR Architecture, the apartment buildings for the multi-family complex will have three unit options:

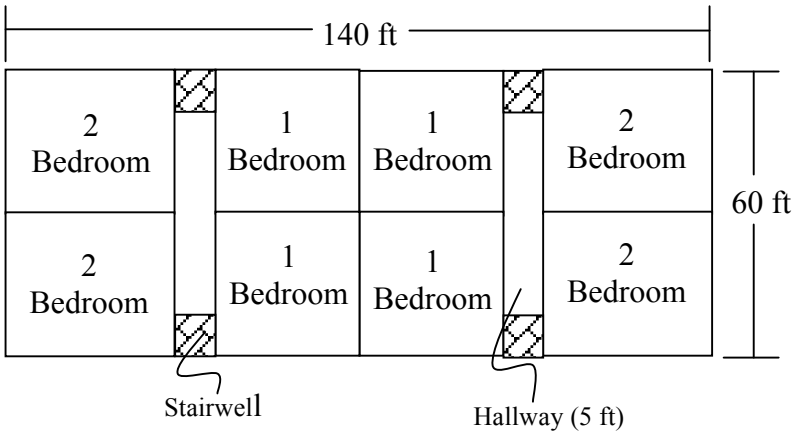
- 1 Bedroom: 900 ft^2 (30 x 30 ft)
- 2 Bedroom: 1050 ft^2 (35 x 30 ft)
- 3 Bedroom: 1400 ft^2 (40 x 35 ft)

Below are the basic layouts for both models as provided by AGR. Please note that while Lever Engineering has taken all reasonable steps to assure the accuracy of these basic drawings, it cannot guarantee that changes or alterations will not be made by persons other than Lever Engineering, LLC.

Model A:



Model B:



2.2 YMCA Specifications

The YMCA will be located on the southwestern edge of the site. The County has required that the building be 10,000 ft^2, complete with a 5000 ft^2 pool and a large athletic field. The building will be two stories high, reducing its footprint to 5000 ft^2. The pool will be located on the west side of the main building and will have 15 ft of surrounding deck. The athletic field is 0.90 acres and is located directly south of the building and pool.

2.3 Child Care Facility Specifications

The County has requested that the child care facility be 10,000 ft^2 and be accompanied with a child play area. According to the Polk County Land Development Code, the play area must have a minimum of 45 ft^2 of useable, safe, outdoor play area per child. Lever Engineering has assumed the facility will care for a maximum of 100 children. Based on this assumption, the play area will be 5000 ft^2 (500 ft^2 over the minimum requirement). The facility must also have a one-way designated pick up loop to facilitate the flow of traffic, and cannot have direct access to a local residential street. The child care center will be located north of the YMCA, with a shared parking lot separating the two buildings.

2.4 Health Clinic Specifications

The health clinic will be located on the north border of the campus adjacent to the main road. The County has required that the building be 14,000 ft^2. To preserve space, the building will be two stories and will have a footprint of 7,000 ft^2. The health clinic will share a parking lot with the library and cultural center, which will be located adjacent to the clinic.

2.5 Library and Cultural Center Specifications

Per the County, the library and cultural center will be one building with a size of 20,000 total ft^2. In an effort to preserve as much land as possible, the building will be a two-story building with a footprint of 10,000 ft^2. The library and cultural center will be located in the northeast corner of the campus, adjacent to the health clinic. As previously mentioned, the library will share a parking lot with the health clinic.

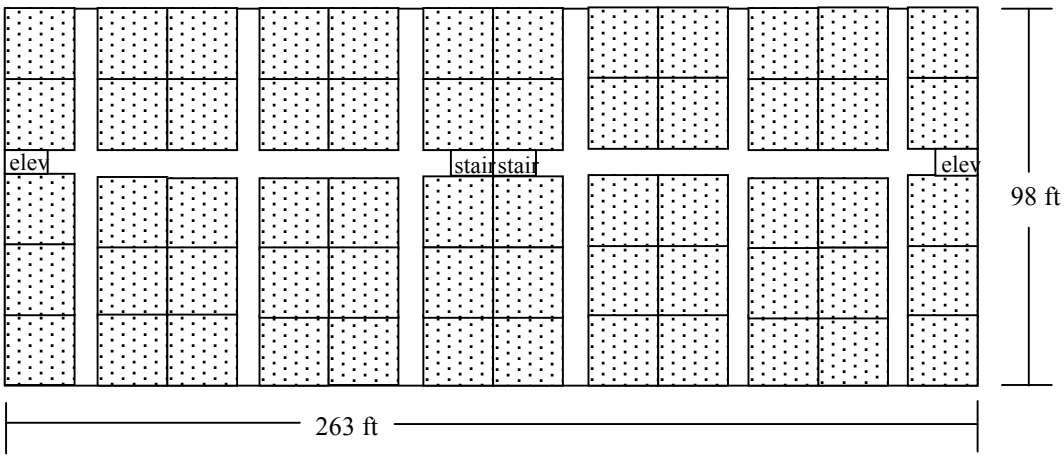
2.6 Recreation and Picnic Area Specifications

The County has required that the campus include a small recreational area that includes a 4000 ft^2 pavilion and a picnic area. Lever Engineering will also include a small facility for restrooms and water fountains. This area will be located in the northern part of the site, alongside the southeastern portion of the wooded area. Lever Engineering will make every effort to minimize the environmental impact to the wooded area.

2.7 Assisted Living Facility Specifications

The assisted living facility will have 120 units, as specified by the County. The facility will be located just south of the retention pond and will include the following support facilities: laundry area, dining hall, large recreation room, administration office, and a nurse's station. Like the multi-family housing, the architectural renderings of the assisted living facility were created by AGR Architecture. The building will be three stories (25,800 ft^2 footprint), housing residents on the top two and support facilities on the first floor. Each unit will be 18 x 18 feet, giving residents 324 ft^2.

Below is the basic layout for the second and third floors as provided by AGR. Two elevators are located at either end of the building and two staircases are located in the middle. The center hallway is 8 feet wide and the supporting hallways are 7 feet wide. Please note that while Lever Engineering has taken all reasonable steps to assure the accuracy of these basic drawings, it cannot guarantee that changes or alterations will not be made by persons other than Lever Engineering, LLC.



3.0 Demolition Plan

The existing property is currently a county park. The park contains four youth baseball fields, one basketball court, three racquetball courts, one concession building, bathrooms, covered picnic areas, and supporting storage and maintenance buildings. All buildings are to be demolished as shown in the demolition plan. The associated parking and access roads are to be removed, including the existing swale in the northeast section of the property. The wooded area in the northwest corner of the property will be preserved along with the site perimeter fence. A total of 35 trees are to be removed and the remaining stumps are to be grinded and removed. See **Appendix G** for an overview of area to be demolished. The cost of clearing, grubbing, and protection of remaining objects is included in the cost analysis.

4.0 Site Paving Plan

4.1 Paving and Curbing Specifications

All curbing on the site is concrete FDOT type 'D'. A total of approximately linear feet of concrete type 'D' curbing is needed.

The light duty pavement will be used in the parking areas. This pavement is composed of 1.25'' of Type S-III asphaltic concrete (structural coarse), 6'' of FDOT limerock base (LBR>100) compacted to a minimum of 98% of its maximum dry density as determined by AASHTO T-180, and 8'' of sub-grade compacted to a minimum of 95% of its maximum dry density as determined by AASHTO T-180. A total of approximately 180,000 square feet of light-duty pavement will be needed.

The heavy duty pavement will be used on the spine road Osprey Court. This pavement is composed of 2.0'' of Type S-III asphaltic concrete (structural coarse), 8'' of FDOT limerock base (LBR>100) compacted to a minimum of 98% of its maximum dry density as determined by AASHTO T-180, and 12'' of sub-grade compacted to a minimum of 95% of its maximum dry density as determined by AASHTO T-180. A total of approximately 26,400 square feet of heavy-duty pavement will be needed. The cost of all paving and curbing is included in the cost analysis.

4.2 Roadway Design

The proposed two-way private access road is anticipated to have a traffic load consisting of mostly passenger cars with occasional delivery and service truck traffic, with occasional buses.

The proposed two-way private access road will be named Osprey Court. The road is 1,095 linear feet in length and 24 feet wide, with 12 foot wide lanes. It is divided by two parallel 4'' wide yellow stripes along its entire length that are offset 4'' from the centerline of the road on each side. The road will be paved using heavy-duty pavement type (See Section 3.0 for details of heavy-duty pavement). Osprey Court is designed to have a crown at the center with a 2% typical slope toward the FDOT type 'D' curbs in order to convey stormwater to the curb inlets. The longitudinal road slope is 1%. Proper signage will be placed alongside Osprey Court to ensure driver safety. A speed limit of 30 mph will be implemented and enforced for Osprey Court.

4.3 Parking Requirements

The parking requirements for each component will be in accordance with the conditions specified in Table 7.10 of the Land Development Code for Polk County. The site will require approximately a total of 500 spaces. The spaces will all be dimensioned as specified in Chapter 7, Section 708. Each parking lot will have landscaping that meets the requirements in Chapter 7, Section 720 of the Land Development Code for Polk County.

4.4 Parking Lot Design

Four parking lots have been design to meet the above stated requirements. The locations of the lots are shown in the site plan. A total of 527 spaces are provided in the design, 21 of which are handicapped spaces. The total area covered by the parking lots is 4.08 acres. Light-duty pavement will be used for all parking lots; therefore 4.08 acres of light-duty pavement will be required for construction.

4.5 Recreational Trail / Sidewalk Design

A recreational walking/cycling trail has been designed to meet pedestrian travel needs for both visitors and residents. The trail runs throughout the site providing safe access to all buildings and parking lots as shown in the site plan. The width of the trail varies between six and seven feet and has an overall length of 5,065

feet. Light-duty pavement will be used for a majority of the trail, with heavy-duty pavement proposed for road crossings. Adequate signage and trail striping will be provided for road crossings and areas with limited site distances.

5.0 Site Grading Plan

5.1 Existing Topography

Based on survey data and on site contours, the topography is very flat, especially in the southern quadrant, having more moderate slopes in the northern quadrant (**Appendix A**). The high point elevation is 154 feet-NAVD, and is found in the center of the site. The low point elevation is 149 feet-NAVD in the northern reaches of the site. Most of the vegetation is thick wooded area in the northeastern quadrant as well as along Coleman Road. The only on site access road is Polk Park Road to provide access to the courts and baseball fields. The site is located outside of the 100-year and 500-year floodplains in Flood Zone X, according to FEMA FERM Panel 12105C0345F Panel 345 of 1045 (Effective Date: December, 200). Therefore no floodplain compensation is needed (See **Appendix A**).

5.2 Grading Plan with Proposed Topography

The attached grading plans are broken down into three sections to better show the details and points. These sections are A, B, C which correlate to the south third, middle third and north third of the site respectively.

The site is graded so that the edge of the property matches the existing grades of the neighboring properties.

The southern half of the site's boundary has conveyance swale running along it to take the stormwater runoff from the offsite contributing areas and convey it to the pond. The swale discharges into three separate FDOT type 'C' ditch bottom inlets. The ditch is a 'V' swale meaning that it has a constant slope on the sides with a point at the bottom. The side slopes have a grade of 1:4. The bottom of the swale has a slope of 0.5% to convey the water to the inlets.

The parking areas are graded to allow the stormwater to flow into FDOT type 'D' inlets which are typically in the middle of the each parking area. The inlet rim elevations are typically set to 152.00 which is above the hydraulic grade line for

the 100 year 24 hour storm event. This will keep water from pooling in the parking lots during the different storm events. The slope of the pavement is typically between 0.5% and 2.0%. These slopes will allow the conveyance of the stormwater while keeping the slope moderate enough to adhere to the ADA rules for handicapped parking.

The spine road Osprey Court is graded to match the existing grades of the entrance from Coleman Road. The road is graded to convey stormwater into FDOT type 'D' curb inlets along different points on the road. The inlets are typically set to an elevation of 152.00 which is above the hydraulic grade line of the 100 year 24 hour storm event. The road is crowned in the middle with a slope of 2% down to the curbing. The longitudinal slope of the road is 1%. The stormwater will flow along the FDOT type 'D' curbing to the nearest curb inlet.

The sidewalks in the site are set to a maximum of a 2% cross slope with a maximum of 4% longitudinal slope. This ensures that the sidewalks comply with the ADA rules for sidewalks. Where the sidewalks enter a roadway curb ramps have been placed with a maximum cross slope of 2% and a maximum grade of 1:12. When a sidewalk borders a parking area the sidewalk elevation is set 6" above the pavement surface.

The building finish floor elevations are set at or above 153.50' which is more than 1 foot above the 100 year 24 hour storm event water level. This ensures that the buildings will not flood during a 100 year 24 hour event.

The pond is sloped at a grade of 1':4'.

6.0 Existing Soil Conditions

Existing soil conditions and geotechnical information are revealed through the services of the NRCS with the Custom Soil Resource Report for Polk County, FL as well as the services of Nodarse & Associates, Inc with a geotechnical report of our area of interest. Based on the soil survey and geotechnical tests we were able to obtain valuable information regarding soil types, properties and characteristics as well as information regarding the water table.

6.1 Surface Soil Conditions

The project site contains sandy soil throughout the 20 acres with pomello fine sand in the southwest and northern quadrants of the project limits and St. Lucie fine sand with 0 to 5 percent slopes covering the majority of the site including the youth baseball fields. Both soil classes can be considered well drained and have high hydraulic conductivities, with St. Lucie slightly more favorable. For hydrological purposes and SCS modeling, the hydrologic soil group of pomello fine sand is C and St. Lucie fine sand is A. The site soil can be considered suitable for the proposed development using shallow foundations not exceeding 2,500 psf for a given footing (See **Appendix A**).

6.2 Sub-Surface Soil Conditions

Based on SPT borings and hand auger borings taken in various locations, there is relatively consistent subsurface conditions across the site. It can be noted that some auger borings showed orangey clay within a 1.5 foot depth of soil which was most likely fill material from an earlier time similar to that used in baseball fields. The borings suggest the groundwater table to be 4 to 5 feet in depth. Hence, excavations or utility installments requiring being 4 feet or more in depth may require temporary dewatering. Based on borings and published information, the seasonal high water elevation is between 2.5 feet and 3.5 feet in below the ground surface varying throughout the site. For conservative stormwater analysis, the seasonal high water elevation will be considered 2.5 feet below existing surface elevations or an average elevation of 148.5 ft-NAVD. Additionally, double ring infiltration tests reveal an infiltration rate of 47.2 inches per hour for the southeast quadrant and 26.5 inches per hour for the northeast quadrant of the site.

7.0 Stormwater / Drainage Plan

Pre- and post-development drainage analysis of the site demonstrates that approximately a 3.8-acre wet retention pond is needed to attenuate the existing discharge rate and to mitigate for disruptions in stormwater quality (See **Appendix B**). The assumptions and requirements for the design and analysis of the proposed drainage system are included below in this section.

7.1 Rainfall Depths

The rainfall depths used in the analysis were obtained using SWFWMD ERP Rainfall Maps and are 7.0 inches and 9.0 inches for the 25yr/24hr and 100yr/24hr rainfall events (See **Appendix B**).

7.2 Rainfall Distribution

For ICPR modeling, an SCS Type II (Florida Modified – Flmod) rainfall distribution and a 256-shape factor was used for pre- and post-development conditions.

7.3 Design Requirements

The following requirements for SWFWMD and Polk County regulations have been achieved during drainage design.

7.4 Water Quantity

The post-development 25yr/24hr discharge rate into the existing Coleman Road ditch outfall should not exceed the pre-development discharge rate per SWFWMD and Polk County regulations. In addition, the post-development 100yr/24hr discharge rate into the existing Coleman Road ditch outfall should not exceed the pre-development discharge rate per Polk County regulations.

7.5 Water Quality

The treatment volume shall be one inch (1'') over the entire basin and shall be discharged in no less than 120 hours with no more than one-half the total volume being discharged within the first 60 hours per SWFWMD regulations. In addition per SWFWMD regulations (Chapter 5, Page 1), a manmade wet detention system shall include a minimum of 35 percent littoral zone, concentrated at the outfall, for biological assimilation of pollutants. The percentage of littoral zone is based on the ratio of vegetated littoral zone to the surface area of the pond at the control elevation. The littoral zone shall be no deeper than 3.5 feet below the design overflow elevation. The treatment volume should not cause the pond level to rise more than 18 inches above the control elevation. The required treatment volume for the site is 1.96 ac-ft. See **Appendix B** for treatment calculations.

7.6 Pre-Development Drainage Conditions

The project site was delineated into one (1) onsite basin which contains off-site contributing areas as shown in **Appendix B**. The onsite basin covers 20.24 acres and the offsite contributing area covers 3.33 acres.

The onsite parking lot has no evidence of any catch basins or stormwater collection systems and thus sheet flows into undeveloped land that drains into the Coleman Road ditch. There is also an onsite swale that runs along the northeastern side of the property that helps to convey runoff and it drains into the Coleman Road ditch.

The pre-development ICPR model was setup to show one basin (the sum of on-site and off-site basins) discharging to the existing Coleman Road ditch. A curve number of 57.6 was used for the pre-development model (See **Appendix B**). A time of concentration of 82 minutes was calculated using a combination of Manning's kinematics solution, shallow concentrated flow and ditch flow (See **Appendix B**). The report of the pre-development ICPR model can be seen in **Appendix B**.

7.7 Post-Development Drainage Conditions

The proposed site has been delineated into three sub-basins using the proposed grading within the project area while the off-basin areas will maintain the same topography. The Runoff Curve Numbers for these sub-basins are shown in **Appendix B**. The proposed wet detention pond was designed to treat and attenuate stormwater runoff produced by the post-development basins.

The proposed wet detention pond has a bottom elevation of six feet below the average seasonal high water table (142.5 ft-NAVD). The proposed littoral shelf elevation is 1.5 feet below the seasonal high water table (147 ft-NAVD). In addition, the design top of berm is at 152.5 ft-NAVD. The outfall structure is

located at the northeast quadrant of the pond and contains a 3.5" diameter orifice at an elevation of 148.5 ft-NAVD which allows no more than one-half of the required treatment volume to be discharged within 60 hours following a rainfall event (See Drawdown Calculations in **Appendix B**). From the treatment calculation in **Appendix B**, the elevation of the weir slot is 149.15 ft-NAVD. The proposed span of the weir slot is 9 inches and rises to the top. The weir allows for water to be discharged at a significantly lower rate than in pre-development

conditions. Additionally, the emergency overflow is 37 by 24 inches per FDOT standards and is set at 151.5 ft-NAVD (See **Appendix B** for drainage details and the ICPR post-development report).

Furthermore, the outfall structure will contain a re-enforced concrete pipe that will discharge into the Coleman Road ditch. The bottom of the structure shall be filled with standard grouting material so that the upstream flow line is at 148.5 ft-NAVD (See **Appendix B**). A Right of Way permit will be required for grading into the off site ditch to ensure a point discharge is avoided.

8.0 Utilities

All utilities inside Osprey Village will be located underground in order to provide the residents with an unobstructed view of the entire development. The following section includes utility service availability and service providers.

8.1 Utility Service Availability

Water and sanitary services will be provided by the Polk County Water Services Group of the Environmental Resources Department. The Polk County Utility Map of the site in question reveals two sewer mains adjoining the area. There is a pressurized sewer main that runs along the perimeter of the site, starting at the southeastern corner, running north-south, and continuing east-west along the southern perimeter. The main continues off the site to an unknown destination.

This pipe is 6 inches in diameter along the eastern edge, and has an 8 inch diameter along the southern edge. The utility map shows that the site also has six reclaimed control valves. These are located along the pressurized sewer main at fairly constant intervals. This main also has two sewer fittings, one on the eastern edge and another at the southeast corner. In addition, the map reveals a gravity sewer main near the area. This main runs north-south along on the eastern perimeter of the additional 10 acre lot and continues on to serve the neighborhood that surrounds the site. This main is 10 inches in diameter. At the northeastern corner of the property, the main has a branch that proceeds east-west for approximately 300 feet into the site. This branch is 6 inches in diameter with a sewer manhole at the branch-off location and at the end. There is also a sewer manhole at the northeast corner of the site on the primary main. A 6 inch water main runs along the southern border of Coleman Road R.O.W., this line will

provide potable water to the site. There is an existing 6 inch well that will be used to provide irrigation water for the site. Refer to **Appendix A** for the utility map of the area.

8.2 Utility Providers

Gas: (*Current onsite availability unknown*)
Agency: Central Florida Gas
Address: P. O. Box 3193 Orlando, Florida 32802
Phone: (407) 423-9018

Electric: (*Available onsite currently*)
Agency: Progress Energy
Address: PO Box 33199 St Petersburg, Florida 33733
Phone: 800 - 700 - 8744

Telephone: (*Current onsite availability unknown*)
Agency: Verizon Communications
Address: 140 West Street New York, NY 10007
Phone: 800 – 483 - 3000

Cable: (*Current onsite availability unknown*)
Agency: Brighthouse Central Florida
Address: 3767 All American Blvd. Orlando, FL 32810
Phone: (407) 291 - 2500

Water (*Available onsite currently*)
Agency: Polk County Utilities
Address: 3767 1011 Kim Keene Blvd Winter Haven, Florida 33880
Phone: (863) 298 - 4100

9.0 Sanitary Sewer Plan

Each building will discharge into a 6 inch gravity sewer leads that is sloped at a rate of 1 foot per hundred. Each lead will then connect to an 8 inch gravity sewer main that runs along Osprey Court. The 8 inch gravity sewer main was designed in accordance with section 22.4 of the Polk County Utilities Technical Standards and Specifications Manual for Utility System Design Construction which states that "All gravity sewers shall be constructed with hydraulic slopes sufficient to give mean velocities, when flowing full or

half full, of not less than 2.0 feet per second, based on Manning's Formula. For all gravity sewers, velocities shall be determined using a value of 'n' of not more than 0.013." The 8 inch gravity sewer main has been designed to have a constant slope of 0.50 feet per 100 feet throughout the development. There are 8 standard 36 inch manholes located throughout the development. The manhole inverts were designed to meet the Polk County requirements that the outflow pipe invert be no less than 0.1 foot lower than the invert of the inflow pipe. See **Appendix G** for a site layout plan illustrating sanitary sewer.

9.1 Lift/Pump Station Design

The 8 inch gravity sewer main described above collects the sanitary flow from all components and discharges into a lift station located in the southwest quadrant of the development. This lift station was designed to provide sufficient capacity in the wet well for a period of 15 minutes at the Peak Hourly Flow (See **Appendix C**). The invert of the 8 inch inflow pipe is located at an elevation of 145.95 feet NAVD and the 6 foot diameter wet well bottom is located at an elevation of 131.95 ft. The low water elevation in the wet well is 131.95 NAVD and the high water elevation is located at an elevation of 144.95 feet NAVD. The 8 inch outflow pipe will rise to an elevation of 149 feet NAVD and exit the lift station. This pipe then connects to the 8 inch force main located along the southern perimeter of the development. The pump for this lift station was sized to overcome the head loss created by the difference in elevation from the well bottom and the existing 8 inch force main located at elevation of 148 feet NAVD and the head loss through the pipe system as well as the 20 psi residual pressure in the 8 inch existing force main (See **Appendix C**). The pump selected is a Hydromatic S4L NON-CLOG with a 10.5 inch impeller. This pump provides the required head to overcome all loses in the system (See **Appendix C**).

10.0 Water Supply Plan

In order to supply Osprey Village with potable water we are connecting to the existing eight inch water main, which has a static pressure of 55 psi and a residual pressure of 48 psi during peak hour demand. This water main is located in the southern right of way for Coleman Road. An 8 inch PVC pipe will connect to this pipe with a tapping sleeve. An 8 inch meter and back flow preventer is placed within the utility easement. This 8 inch line will serve as the trunk line through the site and will run along Osprey Court. All buildings will be supplied with a 6 inch PVC lead, with exception of the park restrooms which will have a 2 inch PVC lead and the lift station which will have a 1 inch PVC lead.

The leads are designed to provide potable water and fire flow requirements for each building. Gate valves are placed along the lines to allow isolation of each line during maintenance. Four fire hydrants connect to the 8 inch line and provide adequate lay length coverage to each building. The furthest fire hydrant from the connection with the existing eight inch water main is Fire Hydrant 3, which shows a residual pressure of approximately 39.5 psi as shown in **Appendix D**. Refer to **Appendix G** for a site layout plan illustrating the potable water system.

11.0 Permitting Requirements

11.1 Environmental Resource Permit (ERP)

An Environmental Resource Permit (ERP) was completed for the SWFWMD basis of review, chapter four, to ensure that any offsite discharge generated from development will be managed. The project was designed so that discharges will meet applicable state water quality standards in accordance with the ERP basis of review, chapter five. Stormwater will be treated with on-site wet detention treatment systems and shall be located no closer than 100 feet from a public water supply well. The application for the ERP will include Sections A, C, and E along with all pertinent information as shown in **Appendix E**. A stormwater management plan was also completed for Polk County Natural Resources Group of the Environmental Resources Department's basis of review. The stormwater management plan also complies with Section 740 of the Polk County Land Development Code.

11.2 National Pollutant Discharge Elimination System (NPDES)

A Notice of Intent of use Generic Permit for Stormwater Discharge from Large or Small Construction (NOI) was completed to ensure that the construction will comply with the National Pollutant Discharge Elimination System (NPDES) as shown in **Appendix E**. This permit will govern and allow the discharge of stormwater during construction activities.

11.3 Stormwater Pollution Prevention Plan (SWPPP)

In accordance to the NPDES and ERP permits, a Stormwater Pollution Prevention Plan was completed to ensure that stormwater discharged during construction will not pollute off-site areas. The plan will provide measures to eliminate/mitigate against pollution created when rainfall events occur during construction.

11.4 Potable Water and Sanitary Sewer Connections

In accordance to the Florida Department of Environmental Protection, a Notice of Intent to use the General Permit for Construction of Water Main Extensions of Potable Water System's was completed to allow for the general contractor of the Osprey Village Development Project to connect to the adjacent existing potable water system as shown in **Appendix E**.

In accordance with the Polk County Board of County Commissioners Transportation Engineering Division, an Application for the Permitting of the Encroachment of Water, Sewer and Reuse Water Related Facilities and Appurtenances was completed to allow the general contractor of the Osprey Village Development project to connect to the adjacent utilities as shown in **Appendix E**.

11.5 Sanitary Sewer System

In accordance to the Florida Department of Environmental Protection, a Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System was completed to allow for the general contractor of the Osprey Village Development Project to construct a sanitary sewer system as shown in **Appendix E**.

11.6 Migratory Bird Nest Removal

In order to allow the removal/relocation of the two onsite osprey bird nests, a migratory bird nest removal permit application has been completed for the State of Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation. The proposed measure to mitigate for the loss of habitat for this species was to relocate the osprey nests from the stadium light posts into the preserved wooded area in the northwest section of the site. A copy of the application is attached in **Appendix E**.

11.7 Permitting Contact Information

Southwest Florida Water Management District
Address: 170 Century Boulevard Bartow, FL 33830
Phone: (863) 534-1448

Florida Department of Environmental Protection
Address: 3900 Commonwealth Boulevard Tallahassee, Florida 32399
Phone: (850) 245-8336

State of Florida Fish and Wildlife Conservation Commission
Division of Habitat and Species Conservation
Address: 620 South Meridian Street, Mail Station 2A, Tallahassee, Florida 32399
Phone: (850) 921-5990 ext. 17310

12.0 Cost Analysis

A preliminary cost analysis of the Osprey Village Development project was performed by Lever Engineering as shown in **Appendix F**. The costs include site grading, paving, all utilities and excavation fees. These costs do not include proposed buildings, engineering, landscaping, irrigation, lighting, soft franchise, testing, dewatering, or any off-site improvements. This estimate is only an engineer's opinion of probable costs. This estimate was based on average industry costs and does not include any potential construction conflicts. The actual construction costs may vary from this engineer's estimate of costs.

Total costs of the project are estimated at approximately $3,200,000.

13.0 Low Impact Development

For the Osprey Village Development, Lever Engineering is recommending that the County opt to develop the site utilizing Low Impact Development (LID). LID is a comprehensive land planning and engineering design approach with a goal of preserving and mimicking the pre-development hydrologic cycle of the developing area. The recommendations included herein are accompanied with function, related benefits, and estimated costs associated with implementation.

13.1 Benefits of Low Impact Development

Should the County opt to follow the recommendations as put forth by Lever Engineering regarding Low Impact Development, Osprey Village will have numerous advantages over traditional developments.

Economically, the County will see only a slight increase in initial budget (discussed further in Section 13.5). This additional cost will be offset over time

by the reduced use of irrigation, fertilizer, and the reduced demand on stormwater management systems.

Publically, Osprey Village will receive widespread support from the citizens of Jan Phyl Village and Polk County as a whole. Osprey Village will be constructed on land that is currently used as a county park, and thus public acceptance of the project will be somewhat difficult to obtain. According to a study performed by Yale University, University of Miami, and Columbia University, 56% of Floridians feel that their mayors should be doing more to address global warming (66% feel that state legislators should better address the issue). The results of this study indicate that Floridians are concerned with the effects development has on the natural environment and would support actions taken to combat these adverse effects. The County's efforts to utilize LID technologies would be applauded by its citizens.

In addition to the aforementioned economic and public benefits, Osprey Village, if constructed using the LID practices named below, will be infinitely more aesthetically pleasing. Trees and native vegetation will add to the ambience of the site and will attract the public.

13.2 Bioretention and Rain Gardens

Bioretention areas (commonly referred to as rain gardens) are a fundamental part of Low Impact Development technologies. These garden areas are filled with low growing native plants (to eliminate the need for fertilizer) in a small depression and promote increased water retention through the root system. Each garden is designed to absorb runoff from impervious areas, such as building rooftops and impervious pavement. Often, gutters, French drains, or graded slopes are designed to divert runoff into the rain garden.

For Osprey Village, Lever Engineering recommends that runoff be directed to these gardens via graded slopes. This will limit additional costs of French drain or piping systems. To maximize the effect of a rain garden, its shape must be longer than it is wide and its placement must be perpendicular to the slope of the area draining into it. For even greater maximum effect, each rain garden should be approximately 20% the size of the area draining into it. Refer to **Appendix H** for a list of recommended shrub species and ground covers per the Polk County Land Development Code Book.

Based on the above guidelines, Lever Engineering has determined that Osprey Village should include a minimum of four (4) rain gardens. In addition, vegetation should be planted along the entire length of the conveyance ditch that encompasses the southern portion of the site. Rain gardens and vegetation are located on the site plan provided in **Appendix H**. The total estimated area of vegetation on the 20 acre site is estimated to be approximately 20,000 square feet. At a cost of $12.00 per square foot, Lever Engineering estimates the cost of all recommended rain gardens and Bioretention swales to be $240,000.

13.3 Pervious Pavement

It is strongly recommended that each of the four parking lots in Osprey Village be constructed with pervious pavement in an effort to reduce the demand on stormwater systems throughout the development. The use of pervious pavement is among the Best Management Practices as proposed by the Environmental Protection Agency to more adequately manage stormwater runoff. The concrete is to be used in each parking stall. Installation of porous pavement is prohibited in drive aisles and roadways to prevent the occurrence of surface raveling. Exact locations of recommended pervious pavement are shown in **Appendix H**.

A choker course must be placed directly beneath the pavement that meets AASHTO No. 57 standards. Beneath the choker course is an aggregate bed large enough for storage while the water percolates naturally into the soil. This bed must be filled with clean, uniformly graded coarse aggregate AASHTO No. 3. The depth of this bed generally varies from 12 – 36 inches. A typical cross section of a pervious lot is included in **Appendix H**.

The County can expect a cost of approximately $9.00 per square yard of pervious pavement including all construction costs (aggregate bed, choker course, etc.). Based on this estimate, installing pervious pavement over all parking stalls would cost the County approximately $90,000. However, the initial cost of asphalt as quoted in the original cost estimate could be subtracted, saving the County nearly $69,000. Additionally, the County can expect the pond size to decrease approximately 8% (due to less stormwater runoff resulting from the pervious pavements), saving another $12,000.

13.4 Canopy Trees

Canopy trees are an integral part of Low Impact Development and are strongly recommended for Osprey Village. By utilizing canopy trees to shade impervious

areas like roadways and buildings, the County can greatly reduce the amount of stormwater runoff produced. Canopy trees allow for the natural capture of water over a large, and otherwise impervious, area.

Per Chapter 4 of the Polk County Land Development Code, a Residentially Based Mixed-Use Development (RBMD) must have at least one (1) canopy tree per 75 linear feet of right-of-way frontage. To better incorporate Low Impact Development, Lever Engineering recommends that Osprey Village contain one (1) canopy tree per 50 linear feet of right-of-way frontage. This recommendation is based on the size of the largest crown spread of acceptable tree species (50 feet) to ensure maximum coverage of all impervious roadways in an effort to minimize both the heat island effect and stormwater runoff. In addition, each planted tree shall be native to the County to minimize fertilizer and irrigation needs. A complete list of recommended tree species and their respective dimensions per the Polk County Land Development Code is available in **Appendix H**.

To qualify as a canopy tree, a tree species must have a minimum diameter of 2 inches at breast height and must be a minimum 10 – 12 feet in height at the time of planting. The species must also be at least 25 feet tall and have a minimum crown spread of 15 feet at maturity per Chapter 4, Section 401 of the County's Land Development Code. Lever Engineering urges the use of Live Oak, as this tree provides the most cover of those listed and the species thrives in Central Florida's environment. Trees of this magnitude generally cost between $200 and $300 delivered and planted, giving a total estimated cost (based on recommendations made by Lever Engineering, LLC) of $7,500.

13.5 Additional Cost Analysis

The costs of the initial project are estimated at approximately $3,200,000 (as shown in **Appendix F**). Should the County adapt the Low Impact Development recommendations as outlined in this report by Lever Engineering, LLC, the total project cost is estimated to be approximately $3,500,000. This results in an additional cost of approximately $300,000 (as shown in **Appendix H**). This is a cost increase of only 10% and thus making it extremely feasible for the County to opt for Low Impact Development for the Osprey Village project.