Some computer-based SLOSH models are also available, such as SLOSH Display Program version 1.65i. These models list several elevations based upon "hurricane scenario," which includes storm intensity, forward speed and track. It is not uncommon for a site located in a Category 4 or 5 storm surge zone to be listed as "dry" for all but one or possibly a few scenarios, and could possibly be dry for all scenarios due to elevation of local grade.

The Division's minimum recommendation for rainfall flood design elevation for EHPA's is ASCE *Flood Resistant Design and Construction* (ASCE 24) Classification Category IV, Essential Facility. That is, the minimum elevation must be at least two (2) feet above base flood elevation (BFE) or a community's Design Flood Elevation (DFE), whichever is greater. However, where determined, the lowest habitable EHPA floor elevation should be at or above the 500-year flood elevation.

G.2.4 Certifications. Board and emergency management agencies have often found that it is difficult, if not impossible, to document that a facility was designed and constructed to the EHPA criteria after the passage of time. Construction drawing notes often do not provide the required information, and building officials, design professionals-of-record, constructors, product manufacturers and providers, and other relevant agents move on to other projects. Maintaining a viable record to certify that a facility has been designed and constructed to meet the EHPA criteria is critical.

The following information is needed by emergency managers to document that a facility is an EHPA:

1. Statement that the wind design conforms to the provisions of the Public Shelter Design Criteria, Section 453.25, Florida Building Code with year of revision specified
2. Statement that the building or EHPA, as applicable, is capable of withstanding or exceeding wind loads according to ASCE 7 structural design criteria (this statement is essential for ARC planners)
3. Basic Wind Speed (V), mph
4. Wind Importance Factor (I); if applicable by standard or code in effect
5. Wind Exposure
6. Wind Directionality Factor (K_d)
7. Internal Pressure Coefficient (GC_{pi})
8. Provide documentation that walls, windows, doors, louvers, roofs, skylights, exhaust fans, rooftop air-conditioning equipment and other exterior components comply with ASTM E 1886 and E 1996, SSTD 12 or other applicable performance standards (e.g., FBC High Velocity Hurricane Zone testing protocols TAS 201, 202 and 203, etc.); documentation may include large missile impact product approval notice(s), certified lab test results, etc.
9. Floor plan drawing or image indicating location of EHPA portions of the facility; includes drawing or image indicating the entire facility when applicable

The documentation can be provided in the form of a certification letter or memorandum, or as a note page within the construction drawings of record. It is requested that the design professionals-of-record sign and seal the certification document(s), and forward the certification to the board, local emergency management agency and Division.

G.2.5 Observations from the 2004 and 2005 Hurricane Seasons. Following the 2004 and 2005 hurricane seasons, federal, state and local building code and mitigation assessment teams observed the types of damages found in the most heavily impacted areas of Florida. In general, the impacted EHPA's performed in a manner similar to other recently constructed light commercial facilities. That is, there were no observed structural failures but improvements were recommended for cladding integrity and weather protection. In particular, roof coverings, light metal exterior wall coverings, soffits and door hardware damage led to rainwater intrusion.

The following is a summary of selected recommendations from the federal Mitigation Assessment Team for critical/essential facilities (which includes shelters):

1. To better ensure adequate performance of shelters, the 40 mph increase in base wind speed should be required and not just "highly recommended."
2. Ensure that appropriate ASCE 7 Exposure Categories are selected during the design process; ensure full wind loads are calculated in open areas (Exposure C) where reductions are not appropriate.
3. The minimum windborne debris impact criteria should be increased from the current SSTD 12/ASTM E 1996 Level D (9 lb 2"x4" @ 34 mph) basic protection to the essential facility Level E (9 lb 2"x4" @ 55 mph) enhanced protection.
4. Assure code compliance through increased enforcement of construction inspection requirements, such as the Threshold Inspection Law.
5. It was recommended that designers calculate loads on building envelope cladding and components (including soffits), roof coverings and roof top equipment and specify/detail adequate attachments to resist the loads. A minimum safety factor of 2.0 is typically recommended. Note that industry or manufacturers' recommendations may be higher than 2.0.
6. For roof coverings, a secondary weather-resistant underlayment is recommended to improve rainwater intrusion protection.
7. Designers should clearly indicate on the construction drawings the area of the facility that was designed to function as the high wind shelter or hardened core area.
8. Perform follow-up inspections every five years or after a hurricane to identify interior moisture damage that may affect the structure or building envelope.
9. It was recommended that designers consider and use guidance found in FEMA P-361 and *Design Guide for Improving School Safety in Earthquakes, Floods and High Winds* (FEMA 424).

To view the full Hurricane Charley and Hurricane Ivan Mitigation Assessment Team Reports, please see FEMA 488 and 489 at the following web addresses:

http://www.fema.gov/media-library/assets/documents/905

http://www.fema.gov/media-library/assets/documents/2338?id=1569

Also, FEMA 424 can be viewed at the following web address:

http://www.fema.gov/media-library/assets/documents/5264

There was one finding during the 2004 hurricane season that is related to human behavior that could increase the vulnerability of shelters. About forty (40) percent of the sites reported that persons (evacuees, shelter staff and managers, and public safety officials) purposely opened windows and doors during hurricane conditions. The reasons for the openings varied from admittance of late arrivals, to smoking, distribution of food and other supplies, fresh air ventilation, and equipment repairs or maintenance. Buildings are designed to be enclosed structures, and openings of possibly as small as one (1) percent of a building's exterior envelope can cause internal pressures that exceed original design loads. This essentially negates the benefits of any added window, door or other envelope protection.

In less intense storms, such as the conditions experienced by most of the shelters in 2004, the effects caused by the openings were minimal, with occupants experiencing only minor atmospheric pressure changes and a temporary, but pronounced, creaking of lightweight roof decks (e.g., metal). However, when doors were opened on building sides perpendicular to or opposite the windward facing walls, the doors occasionally were pulled open violently by suction forces. This may have damaged some doors making them impossible to re-close, and in one case may have broken a door window pane. For additional findings specific to occupied hurricane evacuation shelters during the 2004 season, please see Chapter 5, Performance of Public Shelters during the 2004 Hurricane Season, of the *2005 Shelter Retrofit Report.*

G.2.6 Roof and Utility Enclosure Rainfall Drainage. The EHPA criteria requires that roof drain systems be sized for normal use (i.e., 100-year, 1-hour rainfall design per FBC—Plumbing, Figure 1106.1), and when applicable also required to have additional emergency overflow capacity. The Division recommends that where drainage confining roof perimeter construction or parapets are present, that secondary (emergency) roof drains or scuppers be designed for an eleven (11) inch, 1-hour rainfall rate. This is about a 10,000-year, 1-hour recurrence rainfall rate for Florida, so a low probability event. A rainfall design rate of 8 inches per hour is also consistent with ICC 500 standards for Florida.

The Division also recommends that utility, mechanical, electric and plumbing equipment enclosures with open or screen roofs provide similar emergency rainfall drainage capacity at or near floor or ground level.

G.3 Location and Site Requirements

G.3.1 Emergency Access. EHPA's are required to have at least one major means of access for emergency vehicles that is above the 100-year floodplain. However, this requirement may be impractical in some areas due to generally low-lying topography. Therefore, this requirement can be waived by the board with concurrence of the local emergency management agency or the Division. A potential EHPA with access routes below the 100-year floodplain may be subject to isolation due to hurricane rainfall flooding, and should be reviewed as a potential exemption request per section 2.2.1 of this Plan.

G.3.2 Landscaping and Parking. Landscaping around the EHPA must be designed to preserve safety and emergency access. Trees must not conflict with overhead or underground utilities, including electricity, telecommunications, potable and wastewater, natural gas, etc. Trees, utility poles or other tall structures are required to be located to avoid lay-down or impact hazard for the EHPA and its occupants. The Division recommends that trees located within 50 feet of an EHPA be limited to trunk diameters that do not exceed about six (6) inches at maturity. This recommended standoff distance will prevent medium-size trees from inflicting battering damage to EHPA roofs, walls, windows and doors and reduce the potential for entry and egress door blockage.

Trees that exceed 12 inch trunk diameters may cause most of the lay-down impact damage to buildings. Therefore, the Division recommends that trees that typically exceed 12 inches in diameter at maturity should be located with a standoff distance of more than 100 feet from their base to the closest potential impact point of an EHPA's outside perimeter wall; preferably a standoff distance of more than 115 feet. However, due to their relatively greater height potential, pine trees (e.g., Slash, Spruce, Shortleaf, Longleaf, Loblolly, etc.) should be located with a standoff distance of more than 125 feet from the EHPA; preferably a standoff distance of more than 140 feet.

Structures, equipment and other objects within 300 feet of the EHPA's perimeter should be anchored to avoid generating large windborne, falling or roll-over debris. Vehicles must be parked more than 50 feet from the perimeter of the EHPA during hurricane conditions.

G.3.3 Rainfall Drainage. The civil designer may also want to consider the potential for exceptionally high rainfall rates that will exceed normal site drainage design standards. The following are select maximum single-day (24 hour) rainfall records for locations in Florida:

Pensacola – 11.68 inches
Crestview – 11.44 inches
Apalachicola – 10.67 inches
Tallahassee – 8.86 inches
Jacksonville – 6.33 inches
Yankeetown – 38.7 inches (Florida Record)
St. Petersburg – 15.45 inches
Tampa – 11.45 inches

Orlando – 8.19 inches
Melbourne – 27.65 inches
Fort Myers – 9.92 inches
West Palm Beach – 15.22 inches
Miami – 12.56 inches
Key West – 22.75 inches

Other extreme rainfall events of note for the United States:

Alvin, TX (1979) – 43 inches (NWS national record)
Dauphin Island, AL (1997) – 32.5 inches
Hackberry, LA (1962) – 22.0 inches
Americus, GA (1994) – 21.1 inches

During slow-moving large "wet" hurricanes, a 10 to 20 inch or greater rainfall event is possible. The designer should consider the impact that flooded parking lots, overwhelmed storm drains and retention ponds, closed basin ponding, riverine and sheetflow flooding, and dam or reservoir containment failure may have on an occupied EHPA.

An essential performance requirement of hurricane evacuation shelters is that they not be inundated by rainfall flooding. For design purposes, the Division recommends that the EHPA's civil designer consider the effects of an extraordinary event on the site drainage design. The designer should assume pre-hurricane saturated soil conditions and at-capacity drainage retention structures, then apply a hurricane-caused single-day rainfall event of about 30 inches. This is approximately a point maximum 2,000-year, 24-hour recurrence rainfall rate (1 sq.mi. basin) for most of Florida, so a low probability event.

G.4 Hurricane Evacuation Shelter Capacity

A minimum of fifty percent of the net square feet of certain types of rooms and spaces (referred to as "included spaces") of new educational facilities are required to be constructed to meet the EHPA criteria. The calculated EHPA capacity is used by board staff, emergency managers and design professionals to determine the shelter occupant capacity and infrastructure-related requirements (potable water, toilets, hand washing sinks, parking, etc.) EHPA's may be located in a single large room or a combination of rooms, located on one or more floors, and possibly in more than one building. To begin the EHPA capacity calculation process, identify those rooms or spaces that are to be excluded. Section 453.25.3.1, FBC and s. 252.385(4)(b), Fla.Stat. serve as guides for identifying excluded space.

The following is a summary of the excluded spaces:

Excluded Spaces. Spaces such as mechanical, plumbing, electrical, telecommunication and information technology utility equipment rooms, storage rooms and closets, exterior/outside circulation and open corridors, restrooms and shower areas, kitchen and food preparation rooms, science rooms and labs, computer and information technology rooms and labs, vocational and industrial technology shop areas and labs, library and media rooms and labs, administrative office and support areas, record vaults, attics and crawl spaces.

Included Spaces. All other rooms and areas not listed as an excluded space.

To determine the net square feet of EHPA floor area, subtract the floor area square feet of excluded spaces from the gross square feet of the facility. The board, with the concurrence of the local emergency management agency or the Division may adjust the list of excluded/included spaces or the formula for calculation of design capacity.

Net usable floor area is defined as follows:

Net Usable Floor Area. Floor area of included spaces reduced to account for partitions and walls, columns, fixed or movable objects, furniture, equipment or other features that under probable conditions cannot be removed or stored during use as a hurricane evacuation shelter.

The following empirical usability factors can be used to determine net usable floor area:

1. Reduce the gross floor area of assembly areas with concentrated furnishings or fixed seating by 50 percent. Examples are auditoriums, amphitheater classrooms, etc. To calculate a room's net usable floor area, multiply gross floor area by a **usability factor (UF)** of 0.50.
2. Reduce the gross floor area of assembly areas with unconcentrated furnishings and without fixed seating by 35 percent. Examples are conference rooms, educational classrooms and skills labs, dining areas, band and music rooms, etc. To calculate a room's net usable floor area, multiply gross floor area by a UF of 0.65.
3. Reduce the gross floor area of assembly areas with open floors and without fixed seating by 15 percent. Examples are gymnasiums, dance floors, exhibition galleries, open multipurpose rooms, interior/inside circulation corridors and areas, etc. Retractable seating is not considered fixed seating. To calculate a room's net usable floor area, multiply gross floor area by a UF of 0.85.

A more comprehensive list of Department of Education room design codes, descriptions and UF is available in Appendix H. Usability factors listed are empirical in that they are based upon large-scale typical conditions. Boards, local emergency management agencies and design professionals may adjust the empirical usability factors to address site-specific conditions.

The capacity of an EHPA is calculated using 20 square feet per occupant. The FBC formula is as follows:

(Gross Floor Area – ∑ Excluded Floor Areas) / 20 = Occupant Capacity

To calculate occupant capacity based upon net usable floor area, the formula is:

∑ (Included Gross Floor Areas x UF values) / 20 = Usable Occupant Capacity

The designer should be aware that SpNS "client" occupant capacity is based upon 60 sq.ft. per client. The 60 sq.ft. includes an allowance for care-givers, medical staff, medical equipment and supplies, and a cot or bed. Therefore, no additional space allowance is required for these personnel, equipment or material.

In an emergency, on a short-term basis during hurricane conditions, the American Red Cross and emergency management officials may temporarily reduce the occupant floor area requirement to 15 square feet per occupant. This emergency contingency measure does not affect the EHPA criteria's requirement to use 20 square feet per occupant to calculate design capacity.

The designer should be aware that for adults and children with certain access or functional needs support services (FNSS), such as persons that need wheelchairs or scooters, lift equipment, service animal and/or personal assistance services, FEMA recommends a floor space allocation of 100 sq.ft. For design or planning purposes, the larger accessibility accommodation space may apply to one (1) of every 10 occupants. In some cases the 100 sq.ft. may be shared with a caregiver (i.e., 50 sq.ft. for two of 10 occupant spaces). Additional guidance on space layout considerations can be found in Appendix F and at the following web address:

http://www.ct.gov/demhs/lib/demhs/space__layout_considerations.pdf

To estimate the number of design occupants assuming one (1) FNSS space per 10 occupants, the designer can replace the 20 sq.ft. allowance of the EHPA criteria with 28 sq.ft. Assuming that FNSS space is shared by a caregiver, replace 20 sq.ft. with 26 sq.ft. These will reduce the facility's occupant capacity to account for the additional functional needs space. However, the EHPA criteria do not permit use of the larger design occupant allowance. Therefore, 20 sq.ft. should be used to calculate mechanical, electrical and plumbing related design features.

For planning and guidance purposes only, Table G-2 provides the Division's recommendations for calculating the number of occupants of both evacuation and extended duration shelter types. The floor area allowances apply to all sizes of shelters from small with design occupants of less than 50 to mega-shelters with thousands of occupants. The allowances also include additional accommodation space for persons needing FNSS. The definitions for the shelter types can be found in Appendix E, Glossary. To use Table G-2 (below), replace the code value of "20" in the Occupant Capacity formula(s) given previously with values shown in Table G-2. The calculated occupant capacity will provide the number of occupants with a reduction for FNSS spaces.

As an example, a risk evacuation shelter with a total of 10,000 gross sq.ft. of floor area and 0.85 usability factor, replace the “20” with “26” as follows:

(10,000 x 0.85) / 26 = 326 occupant spaces

Of the 326 total occupant spaces, two of 10 (or 2:10) are based on 50 sq.ft. each (65 FNSS spaces), and the remaining eight of 10 (8:10) are based on 20 sq.ft. each (261 code minimum/standard spaces).

Table G-2. Florida Shelter Occupant Space Calculation Recommendations with FNSS for Dormitory Areas

Type of Shelter (Duration of Shelter Occupancy)	Floor Area Minimum Recommendation, average net usable sq.ft.	Floor Area Range, average net usable sq.ft.
General Population		
Risk Evacuation Shelter (0-72 hours)	26	22-46
Host Evacuation Shelter (0-72 hours)	26	26-46
Recovery/Short Term Shelter (72 hours - 2 weeks)	42	42-64
Long Term Shelter (more than 2 weeks)	60	60-82
Special Needs Population		
Risk Evacuation Shelter (0-72 hours)	60	60-82
Host Evacuation Shelter (0-72 hours)	60	60-82
Recovery/Short Term Shelter (72 hours - 2 weeks)	80	80-100
Long Term Shelter (more than 2 weeks)	100	100-120

G.5 Plumbing and Sanitation

It is essential that the EHPA remain a safe and sanitary environment. The plumbing and sanitary provisions of the EHPA criteria are primarily based upon the American Red Cross’s *Mass Care Standards and Indicators, Version 011-072209* (Mass Care Standards). Mass care Standards requires that emergency shelters, regardless of cause(s) necessitating their need, provide a minimum level of service.

In general, support systems for toilets, sinks and other essential water distribution and disposal systems are required to be capable of supplying water and containing waste for the design capacity of the EHPA. Plumbing and valve systems of toilets and sinks within the EHPA may be designed for conversion to emergency operation to meet the required demand. The method selected to achieve the required level of performance is at the discretion of the board, design professionals and emergency management agencies.

It should be noted that EHPA plumbing and sanitation design requirements should not be reduced for pre-designated SpNS facilities. SpNS client capacity is calculated based on 60 sq.ft. per client instead of the 20 sq.ft. used for the general population. This may give the appearance of a reduced design load for critical support systems. However, the 60 sq.ft. includes an allowance for care-givers and the additional medical service staff necessary for operating the shelter. Therefore the plumbing and sanitary systems must be designed to accommodate a loading condition similar to that found in general population shelters.

G.5.1 Potable Water. Neither the EHPA criteria nor Mass Care Standards specify a minimum potable water requirement. ICC 500 design standards require a minimum of one (1) gallon of potable water per person for all uses (i.e., drinking water, hygiene, food preparation, etc.) The Division doesn't recommend a potable water design of less than one (1) gallon (3.8 liters or 0.133 cubic feet) per person for all uses. A minimum of two quarts (1/2 gallon or 2 liters) per person should be for drinking water purposes. As an example, an EHPA with a design occupant capacity of 250 persons (includes both evacuees and management staff) will require a minimum of 250 gallons (950 liters or 33.3 cubic feet) of potable water. This is a relatively small quantity of water if it must be extended for more than 24 hours, so conservation measures are recommended (i.e., identify and provide access to sources for clean non-potable water for toilet flushing and certain other hygiene activities, etc.)

Both the shelter environment (temperature and humidity) and physical condition/health of evacuees (e.g., age, diet, medications, pregnancy/ nursing, etc.) can significantly affect drinking water needs. Table G-3 can be used as a guide to estimating minimum drinking water needs as shelter temperatures rise. A potable water design of 3 to 7 gallons per occupant per day may be more appropriate.

Table G-3. Estimate of Minimum Daily Drinking Water Needs in Unconditioned Shelters

Shelter's Daily Mean Temperature, °F	Daily Drinking Water Needs[1], quarts (liters)		
	Normal Demand (normal activity or at rest)	Moderate Demand (moderate work load)	High Demand (hard work load)
70 °F	2 (1.9)	3 (2.8)	5 (4.7)
80 °F[2]	3.5 (3.3)	5 (4.7)	7.5 (7.1)
90 °F[3]	6 (5.7)	8.5 (8.0)	11.5 (10.9)
100 °F[4]	8.5 (8.0)	12 (11.4)	15 (14.2)

[1] - Source: *Medical Aspects of Harsh Environments, Volume 1*, 2001, Chapter 1 Introduction to Heat-related Problems in Military Operations, Figure 1-3
[2] - Caution: 80 - 90°F Fatigue possible with prolonged exposure
[3] - Extreme Caution: 90 - 105°F Heat exhaustion possible with prolonged exposure
[4] - Danger: 105°F or higher; Heat stroke possible with prolonged exposure

The potable water can be provided by on-site wells or water treatment package plants, stored in a permanent flow-through tank, or less preferably, stored in temporary containers or bladders. Temporary systems will be infrequently used (possibly less than once a year) they will require regular maintenance to ensure operational viability. Large volume tanks must also be monitored to assure sufficient chlorine residual. Systems that rely on pumps or other electro-mechanical equipment or devices will require a back-up power supply.

In some circumstances, an alternative to large volume tank storage, and its associated plumbing and valve systems, is on-demand delivery of potable water. If this approach is used, the EHPA will need a delivery and protected storage area for the bulk water. This approach has significant benefits and drawbacks. The benefits are minimal (or no) construction costs associated with this approach, and there are no recurring maintenance or contamination concerns. The drawbacks are logistical and financial: who is going to be responsible for ordering, receiving, distributing, paying for, and if necessary, disposing of the water in time of need? These issues are not show-stoppers, but require a written agreement to assure operational viability.

G.5.2 Toilets and Sinks. The EHPA criteria require one (1) toilet and one (1) sink per 40 occupants of design capacity. The toilets and sinks can be fixed units incorporated into the EHPA during design and construction, or less preferably portable/temporary toilets and hand washing facilities. The EHPA required toilets and sinks are not in addition to those required for normal school occupancy, and are to be included in the overall facility fixture count. Generally there are sufficient quantities of toilets and sinks required for normal school occupancy capacity to meet the EHPA requirement. The designer will need to consider placement of the fixtures such that the needs of both the normal school occupancy and the EHPA are served.

EHPA required toilets and sinks must be available (or reachable) from within the protected area, or must be available via a protected passageway that meets the EHPA criteria. Portable chemical toilets may also require separation from occupied spaces and circulation of fresh air. Also, consider how a portable toilet will be delivered, serviced and removed from the facility. This may require a larger door opening than normal and the use of removable door frame mullions.

For adults with certain access or functional needs, low-profile toilets, sinks and grab bars installed in elementary classroom water closets and toilet rooms may be inadequate. The Division recommends that the designer incorporate permanent or adaptive structural and fixture size elements that can safely and expediently accommodate adults with functional or access needs. The adult toilets may also be incorporated into the design by adding adult restrooms into EHPA floor plan.

The American Red Cross' *Mass Care Standards and Indicators* (Mass Care Standards) recommends that on average there be one toilet and hand washing sink per 20 persons.

G.5.3 Showers. Given that the EHPA criteria assume only an 8-hour occupancy, normal shower requirement can be relaxed. Therefore, showers are not an EHPA code requirement. However, boards and design professionals should consider that in a post-hurricane recovery environment, Mass Care Standards normally require one (1) shower per 25 occupants.

G.5.4 Wastewater. The EHPA criteria require that the plumbing system be capable of containing (or otherwise disposing of) the wastewater generated by the design capacity occupant load. During the 2004 and 2005 hurricane seasons, about 30 percent of occupied hurricane evacuation shelters experienced wastewater/sewage back-up into the facility. It is critical that wastewater be prevented from backing up into the EHPA. This can be accomplished through installation of storage tanks, a wastewater treatment package plant, or other suitable measure.

For those facilities with an on-site wastewater lift station, the lift station reservoir can be sized to meet the storage requirement. The lift station reservoir must be set at a lower elevation than the EHPA to prevent back-up of wastewater into the shelter area. The lift station should also be equipped with a standby back-up power system to support drainage into the local utility system. As a contingency, the stored wastewater can be drained and properly disposed of by a mobile pump unit.

Instead of a tank, an alternative is to utilize the waste drain pipe as the storage container. In this method, the pipe is over-sized to accommodate the required volume of waste on the facility side of the back-flow preventer. Wastewater and sewage back-up is normally caused by continued disposal (or flushing) of wastewater into the drain pipe system after the utility side back-flow preventer has closed; the drain pipe has insufficient capacity for continued use. With an over-sized drain pipe, the waste is stored in the pipe until the utility system is restored. A drainage connection or fixture should be incorporated into the drain pipe to accommodate expedient drainage and proper disposal by a mobile pump unit.

The Division recommends that the wastewater system design be based upon a ratio of 1.5 gallons wastewater for every gallon of potable water. In addition to the basic potable water design volume, the 1.5:1 ratio provides extra capacity for solid materials and introduction of non-potable water into the system (e.g., toilet flushing). Thus, based upon a minimum recommended potable water load of 1 gallon per occupant, the minimum recommended wastewater capacity is 1.5 gallons (0.2 cubic feet) per occupant. The Division recommends that the reservoir capacity be based upon a 24-hour design occupant capacity instead of the 8-hour design capacity (i.e., 3 to 5 gallons per occupant instead of 1 gallon). As an example, an EHPA with a design occupant capacity of 250 persons (includes both evacuees and management staff) will require a minimum wastewater storage capacity of 1,250 gallons (166.7 cubic feet).

G.5.5 Garbage Disposal. The Division recommends that janitorial service areas be located within the EHPA, and provisions be considered for temporary storage or disposal of solid wastes and garbage. Mass Care Standards recommends one (1) 30 gallon waste receptacle/container with lid and trash bags for every 10 persons.

G.6 Electrical Standby and Emergency Power System

Back-up and emergency power provisions are an important feature for hurricane evacuation shelters. Utility electrical power can be disrupted for a few hours to several days (or possibly weeks) following arrival of hurricane conditions. During a utility electrical power outage, EHPA's must remain a safe and sanitary environment. Life-safety systems must continue to function, minimal lighting must be provided to support safe movement, security and emergency egress needs, and adequate ventilation provided to maintain a habitable environment.

At a minimum, the EHPA criteria require installation of an standby electrical power system with an outlet for coupling to a back-up portable generator. The EHPA criteria do not require installation of a permanent electrical power generator, but rely on emergency battery power and "pre-wiring" the facility's electrical system to accept expeditious and safe installation of a compatible portable generator. Therefore, the minimum EHPA requirement relies upon on-demand delivery of a compatible electrical power generator. If the on-demand approach is used, the EHPA will need a protected storage area for the generator.

The on-demand approach has significant benefits and drawbacks. The benefits are reduced initial construction costs, minimal recurring maintenance expenses and no fuel-degradation concerns. The drawbacks are logistical and financial: who is going to be responsible for ordering, receiving, installing, maintaining, refueling, redeploying and paying for the generator in time of need? Very few, if any, boards or local government agencies possess an adequate quantity of compatible portable generators to meet EHPA requirements. Also, state and federal agencies do not normally deploy portable emergency power generators until at least 24 hours after impact by hurricane conditions, and in many cases it may be more than 72 hours. These issues are not show-stoppers, but require emergency power provisions be included in board and local facilities and emergency operations plans (and possibly a written agreement) to assure operational viability.

Boards and design professionals must note that state and local emergency management agencies are under no statutory or code obligation to provide portable emergency generator(s) for EHPA's. Boards and design professionals are responsible for developing an appropriate EHPA emergency power capability to maintain a safe and sanitary environment for at least the required 8-hour minimum design occupant capacity.

For facilities that are pre-designated to serve as SpNS facilities, the Division strongly recommends that the standby emergency power system be designed to accommodate additional branch circuits to support medical equipment, refrigeration of medical supplies and air-conditioning of client occupied areas. These special requirements may exceed basic EHPA design criteria, but post-construction retrofitting to accommodate these requirements is often difficult and costly. The Division strongly encourages the designer to coordinate with local emergency management and county health department staff when designing a facility that is pre-designated as a SpNS.

G.7 Emergency Management Considerations

G.7.1 Shelter Manager's Office. The EHPA criteria require that an administrative office be identified for shelter management use and included within the EHPA. The office is required to have provisions for standby power, lighting, communications, main fire alarm control panel and storage for the manager's equipment. Communications may include both internal (within the EHPA) and external (to outside shelter support agencies) communications.

The EHPA criteria do not specify a minimum floor area requirement for shelter management needs. ARC 4496 recommends that shelter management functions be based upon a minimum of 40 square feet per staff person. Therefore, the Division recommends that the shelter manager's office be a minimum of 40 square feet of net floor area, and an additional 40 square feet per assistant manager(s), communications person(s) and equipment storage. As an example, assuming the shelter manager and assistant manager occupy a single office area with equipment storage, the shelter manager's office should have about 120 net square feet of floor area (i.e., 40 sq.ft. x 3 management functions = 120 sq.ft.) The communications person(s) may be located in adjacent spaces.

G.7.2 Signage. A sign with a floor plan drawing or image indicating the EHPA's location and perimeter boundaries or limits is required to be mounted in the shelter manager's office.

G.7.3 Food Service. The EHPA criteria states that "where feasible, include counter tops for food distribution functions in the EHPA's." Mass Care Standards requires that emergency shelters have a feeding area and a means of storing, preparing and distributing food (and concurrently drinking water). Ideally, for sanitation purposes, emergency managers and shelter support agencies prefer to have feeding-related areas separate from general population areas. However, to maximize utilization of the EHPA's floor area during hurricane conditions, this preference can be relaxed and feeding areas occupied by a shelter population.

Mass Care Standards normally requires 2,000 Calories per person per day (about three pounds of unprepared food). However, on a temporary basis, a hurricane evacuation shelter's feeding services can be relaxed. For design purposes, the EHPA planning assumption is 8-hours, or one-third (1/3) of a day. Therefore, at a minimum the Division recommends that boards and design professionals plan for distribution of about one-third of the ARC's daily requirement, or about 667 Calories (about one pound per person). This minimum feeding requirement can be met via "bag lunches" or heavy snacks. As an example, an EHPA with a design occupant capacity of 250 persons (includes both evacuees and management staff) should have a minimum of 250 pounds of food. Given that bag lunches and one-quart containers of bottled water can be distributed from a movable table (or straight out of bulk delivery boxes or containers), a fixed counter top may not be required; thus the "where feasible" preface in the code.

G.7.4 Supplemental Space Allocations. Ideally, in addition to shelter management space needs, adequate space should be set aside within the EHPA for registration, emergency medical care, safety and fire considerations, janitorial services and sanitation. For post-hurricane recovery shelter operations, Mass Care Standards also recommends addition of space for storage of bulk food and supplies, food preparation and feeding, separate rooms for general population, elderly and families with small children, sleeping areas, recreation, and possible storage of occupants' belongings.

G.7.5 Parking. EHPA vehicle parking areas may be paved or unpaved, but must be located more than 50 feet from perimeter of the EHPA. This doesn't apply to temporary emergency vehicles, occupant/client or supply drop-off parking that will be cleared out during hurricane conditions.

G.8 Americans with Disabilities Act Shelter Requirements. The Americans with Disabilities Act (ADA) requires that public shelters provide equal access and service to all persons. For guidance reviewing accessibility of existing facilities as emergency shelters please see Appendix L.

Additional guidance can be found in *Guidance on Planning for Integration of Functional Needs Support Services in General Population Shelters* (FEMA, November 2010), which can be found at the following web address:

http://www.fema.gov/pdf/about/odic/fnss_guidance.pdf

G.9 Comparison of Florida's EHPA to the International Code Council's ICC 500
The ICC 500 was published in August, 2008 and updated October 2014. Florida's EHPA code provisions were considered during preparation of ICC 500 so there are many design consistencies between them. However, the objective of the ICC storm shelter committee was to ensure a high-degree of safety and broader occupancy requirements. Therefore, wind design provisions are based on a near-ultimate hurricane event. Table G-4 provides a limited comparison of Florida's EHPA criteria and ICC 500.

Table G-4. Comparison of Florida Building Code's Public Shelter Design Criteria (EHPA) and the International Code Council's ICC 500 Hurricane Shelter Standard

Design Criteria	2017 FBC—Building (5th Edition), EHPA	ICC 500—2014, Hurricane Provisions
2017 Florida Building Code-- Building **References**	Section 453.25	Section 423
Design Occupancy Period	8 hours	24 hours
Net Usable Floor Space per Occupant	20 sq.ft. all adults and children five years or older	20 sq.ft. for standing, seated or wheelchair; 40 sq.ft. for bedridden

Table G-4. Comparison of Florida Building Code's Public Shelter Design Criteria (EHPA) and the International Code Council's ICC 500 Hurricane Shelter Standard		
Design Criteria	**2017 FBC—Building (5th Edition), EHPA**	**ICC 500—2014, Hurricane Provisions**
Sanitary Facilities	Toilets 1:40 Handwashing 1:40	Toilets 1:50 Handwashing 1:100
Potable Water Capacity, minimum quantity	No Capacity Given	1 Gallon per Occupant
Waste Water Capacity, minimum quantity	No Capacity Given	1.5 Gallons per Occupant
Flood Design Criteria	ASCE 7 and ASCE 24	ASCE 7, Section 5 and ASCE 24
Storm Surge Flood Elevation (if applicable)	EHPA must be located outside Category A, B and C evacuation zones.	No limitation on location inside a hurricane evacuation zone. Lowest shelter floor slab must be elevated above the maximum modeled hurricane category, including coastal wave effects (i.e., Category 5 hurricane for Florida).
Inland Rainfall Flooding	ASCE 24, Risk Category IV Classification. Floor slab of lowest finished floor must be elevated above base flood elevation (BFE) plus two (2) feet or local design flood elevation (DFE), whichever is higher.	Lowest floor slab of occupied shelter must be elevated to the higher of the following elevations at the site: 1) flood having 0.2% annual chance; 2) flood elevation of the highest recorded flood if no flood hazard study in the area; 3) hurricane storm surge/see design criteria above; 4) minimum flood elevation of the lowest floor required by the authority having jurisdiction; and, 5) two (2) feet above 1% annual chance.
Rain Loads and Drainage	FBC (100-year recurrence interval for both normal and emergency overflow; no additional rainfall rate capacity provided)	ICC 500, Section 303.1 (100-year recurrence interval plus 3 inches per hour normal drains, and 100-year plus 6 inches per hour for secondary/emergency overflow; ranges from total of 10.3 to 11 inch emergency overflow capacity for Florida)
Hurricane Wind Load Design	ICC 500	ASCE 7 with design wind speeds per ICC 500 Chapter 3
Minimum Design Wind Speed	ICC 500	ICC 500 Hurricane Wind Speed Map (10,000 year recurrence)

Table G-4. Comparison of Florida Building Code's Public Shelter Design Criteria (EHPA) and the International Code Council's ICC 500 Hurricane Shelter Standard

Design Criteria	2017 FBC—Building (5th Edition), EHPA	ICC 500—2014, Hurricane Provisions
Importance Factor, *I*	Not Applicable	Not Applicable
Directionality Factor, K_d	ICC 500	1.00
Optional Increase in Design Wind Speed	Not Applicable	Not Applicable
Exposure Classification	ASCE 7	ASCE 7 Exposure C (Exposure B may be applied to MWFRS in certain situations)
Enclosure Classification	ASCE 7	ASCE 7 with largest door or window on each side individually considered an opening (breach)
Load Combinations	ASCE 7	ASCE 7 with ICC 500 Section 304 provisions
Building Enclosure Missile Impact Criteria (all exterior surfaces)	FBC	ASTM E 1886 and E 1996 with modifications (large missile: 9 lb 2x4 Vertical Surface=0.5*Design Wind Speed, and Horizontal Surface=0.1*Design Wind Speed)
Impact Testing Procedures	ASTM E-1886 and ASTM E-1996 or SBC/SSTD 12	ASTM E 1886 or E 1996 as modified by ICC 500 Chapter 8
Weather Protection (rainwater intrusion)	Exterior envelope and air intakes/vent assemblies must meet design wind loads; Roof covering to be specified and designed to meet wind uplift forces and meet ASTM and Factory Mutual Standards	All exterior components and cladding assemblies and roof coverings must be designed and installed to meet design wind loads
Fire Separation	Applicable Code	Applicable Code or 2-hour fire resistance rating of walls/assemblies, whichever is greater, that separate shelter areas from the host building
Natural Ventilation	S. 453.13.8.1, FBC—Building (5 % of internal floor area as net free open area equivalent in exterior walls of rooms on perimeter of building, with exceptions)	12 net sq.in. of vent area openings per occupant

Table G-4. Comparison of Florida Building Code's Public Shelter Design Criteria (EHPA) and the International Code Council's ICC 500 Hurricane Shelter Standard		
Design Criteria	**2017 FBC—Building (5th Edition), EHPA**	**ICC 500—2014, Hurricane Provisions**
Mechanical Ventilation	2 cfm per sq.ft. of EHPA floor area	Ventilation rate determined by applicable building code for normal use of space (typically 15 cfm per occupant)
Emergency Lighting	FBC	1 foot-candle (11 lux)
Standby Lighting	10 foot-candle (110 lux)	10 foot-candle (101 lux)
Standby and Emergency Power System(s), minimum loads	Required; minimum loads: emergency lighting, illuminated exit signs, fire protection, alarm and sprinkler systems, ventilation for health/safety purposes, and four (4) electrical receptacles in shelter manager's office	Required; minimum loads: critical branch lighting and life safety systems, and select HVAC circuits as required by authority having jurisdiction
Standby Electric Power System, optional loads	1. Remainder of the school's campus security lighting (building and site); 2. Additional ventilation circuits; 3. Intercom system; 4. Food storage equipment; 5. Additional electric receptacles; and 6. Additional non-life safety systems deemed necessary by local officials for health, welfare and safety of the public during occupancy	Not Applicable
Permanently installed Standby Electric Generator	Not Required	Not Required
Special Inspections	EHPA's are designated "threshold buildings" and subject to special structural and electrical inspections	Community shelters are subject special inspections and structural observations
Peer Review	Not Required	Construction documents for community shelters with design occupancies greater than 50 are subject to peer review

EXHIBIT 5

FIGURE 1609B-ULTIMATE DESIGN WIND SPEEDS-RISK CATEGORY III & IV BUILDINGS AS ADOPTED BY LEE COUNTY

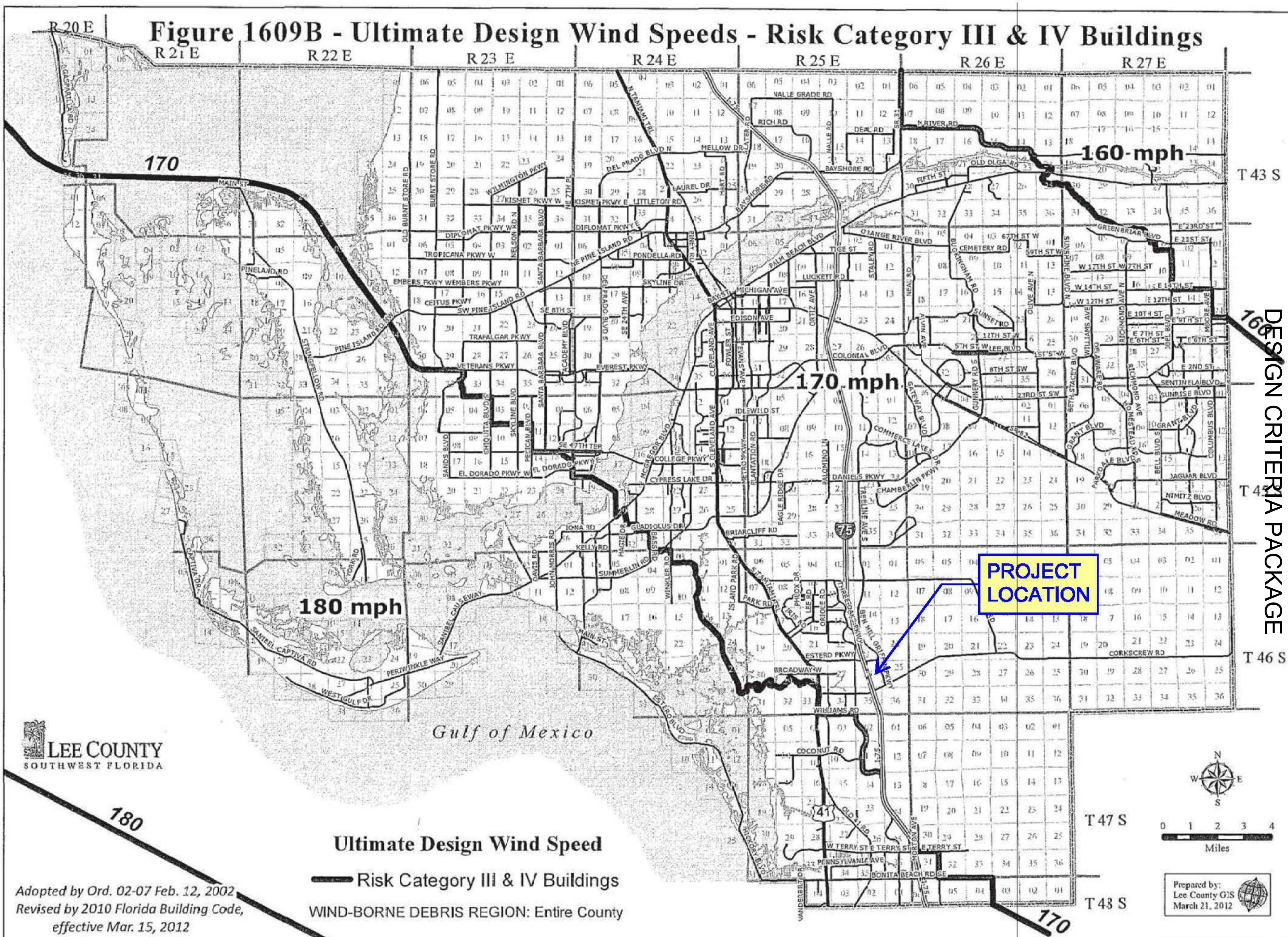
Figure 1609B - Ultimate Design Wind Speeds - Risk Category III & IV Buildings
R 20 E
R 21 E
R 22 E
R 23 E
R 24 E
R 25 E
R 26 E
R 27 E
T 43 S
T 46 S
T 47 S
T 48 S
160 mph
170 mph
180 mph
170
180
PROJECT LOCATION
Gulf of Mexico
LEE COUNTY
SOUTHWEST FLORIDA
Ultimate Design Wind Speed
Risk Category III & IV Buildings
WIND-BORNE DEBRIS REGION: Entire County
Adopted by Ord. 02-07 Feb. 12, 2002
Revised by 2010 Florida Building Code, effective Mar. 15, 2012
Miles
Prepared by:
Lee County GIS
March 21, 2012

EXHIBIT 6

COMPONENTS AND CLADDING PRESSURES - ULTIMATE

Zone	Area, sf	Pressure, psf	Suction, psf
f Field 1	10	22.8	-56.1
	50	19.5	-52.8
	100	18.1	--51.4
f Edge 2	10	22.8	-94.2
	50	19.5	-70.9
	100	18.1	-60.9
Corners 3	10	22.8	-141.7
	50	19.5	-70.9
	100	18.1	-60.9
l Field 4	10	51.4	-55.6
	20	49.1	-53.4
	50	46.1	-50.4
Corners 5	10	51.4	-68.4
	20	49.1	-63.9
	50	46.1	-57.9

a=22.8 feet

Reference ASCE 7-10, Table 30.7-2, C&C Wall and Roof Pressures for definitions of Zones

EXHIBIT 7A
ROOF CARE MAINTENANCE PLAN 2018 FOR GERMAIN ARENA, BY WEST COAST FLORIDA ENTERPRISES, INC.

West Coast
Florida Enterprises, Inc.

Roof Care Maintenance Plan 2018

For

Germain Arena

11000 Everblades Parkway

Estero, FL 33928

WEST COAST FLORIDA ENTERPRISES, INC.

West Coast Roofing and Waterproofing - Structural Injection Systems - Collier County Roofing

8090 Supply Drive, Fort Myers, FL 33912 * 239-433-9777 * 239-433-9778 Fax

www.westcoastFLenterprises.com * www.structuralinjectionsystems.com * www.colliercountyroofing.com

EXHIBIT F
DESIGN CRITERIA PACKAGE

West Coast Florida Enterprises, Inc.

8090 Supply Drive ● Fort Myers, FL 33912 ● (239) 433-9777
Fax (239) 433-9778 ● Website: www.westcoastFLenterprises.com

Annual Roofing - Maintenance Inspection Checklist

NAME: Germain Arena
ADDRESS: 11000 Everblades Parkway
CITY: Estero
SECTION: Main roof
MEMBRANE: Firestone PVC Installed 1998

DATE: 06/12/2018
INSPECTOR: Bill Fortin
SQ FT:

ITEM	CONDITION			DESCRIPTION
	OK	Minor	Major	
1. REGULAR MAINTENANCE				
a) Pitch Pans				Does not apply
b) Caulking		✓		
2. ROOF CONDITION				
a) General Appearance				
i) Ponding Water	✓			
ii) Debris	✓			
iii) Physical damage			✓	Holes and cuts
b) Surface Condition				
i) Bare Areas				Does not apply
ii) Aligatoring / Cracking		✓		
iii) Other			✓	Temp repairs
c) Membrane Condition				
i) Blistering				Does not apply
ii) Splitting	✓			
iii) Ridging / Wrinkling		✓		
iv) Fishmouthing				Does not apply
v) Fastening			✓	Rusted and loose fasteners
vi) Shrinkage		✓		
vii) Open Lap's			✓	Throughout the roof system
d) Drains				
i) Clear				Does not apply
ii) Cages				Does not apply
iii) Rings				Does not apply
iv) Bolts				Does not apply

EXHIBIT F

DESIGN CRITERIA PACKAGE

3. FLASHINGS				
a) Roof Perimeter				
i) Deterioration		✓		
ii) Punctures			✓	Holes and cuts
iii) Attachment			✓	Loose fasteners
iv) Blisters				Does not apply
v) Open Laps			✓	
vi) Fasteners			✓	
b) Counterflashing / Termination				
i) Damage				Does not apply
ii) Fasteners				Does not apply
iii) Caulking				Does not apply
iv) Rusting				Does not apply
v) Other				Does not apply
c) Coping				
i) Damage				There is no coping on roof
ii) Fasteners				Does not apply
iii) Caulking				Does not apply
iv) Rusting				Does not apply
v) Other				Does not apply
4. PENETRATIONS				
a) Curbs / Penetrations				
i) New Penetrations				There are no penetrations on roof
ii) Open Laps				Does not apply
iii) Punctures				Does not apply
iv) Fastening				Does not apply
v) Caulk / Clamps				Does not apply
vi) Other				Does not apply
b) Equipment Housings				
i) Counterflashing				Does not apply
ii) Physical Damage				Does not apply
iii) Caulking				Does not apply
iv) Other				Does not apply
c) Equipment Operation				
i) Drainage / Spillage				Does not apply
ii) Excessive Traffic	✓			
iii) Other			✓	Temp repairs
5. EXPANSION JOINTS				
a) Open Joints				There are no expansion joints on roof system
b) Punctures				Does not apply
c) Fasteners				Does not apply
d) Other				Does not apply

NOTES: East edge of roof has temporary repairs from Irma. Major damage to exterior wall of building. Temporary repairs throughout the roof system.

HURRICANE PREPAREDNESS CHECKLIST

BUILDING NAME:	Germain Arena	**DATE:**	06/12/2018
BUILDING ADDRESS:	11000 Everblades Parkway	**SECTION:**	Main roof

ITEM	OBSERVATIONS			DESCRIPTION
	OK	Minor	Major	
A. HVAC / PLUMBING / ELECTRICAL				
(1) Units attached / strapped				Does not apply
(2) Units door panels intact				Does not apply
(3) Vent hoods secured				Does not apply
(4) Condensation lines secured				Does not apply
(5) Duct work secured				Does not apply
(6) Conduits secured				Does not apply
(7) Satellite dishes secured				Does not apply
B. SHEET METAL AND TRIM				
(1) Coping secure				Does not apply
(2) Gravel stop secure			✓	Metal was blown off on east end of roof
(3) Gutters secure	✓			
(4) Downspouts secure			✓	
(5) Exterior siding / trim secure			✓	Metal was blown off in hurricane and has not been replaced
(7) Counterflashing secure				Does not apply
C. ROOF DRAINAGE				
(1) Roof drains functioning				There are no roof drains - only gutters
(2) Roof drains clear				Does not apply
(3) Roof scuppers clear				Does not apply
(4) Gutters clear	✓			
(5) Downspouts clear	✓			
D. ROOF MEMBRANE				
(1) Seams secure			✓	
(2) Insulation shifting			✓	
(3) Punctures / tears			✓	
(4) Perimeter securement			✓	
E. MISCELLANOUS ITEMS				
(1) Debris	✓			
(2) Plumbing vents				Does not apply
(3) Vents / stacks / colars / caps				Does not apply
(4) Roof damage by others	✓			
(5) Other			✓	Flat gravel built up roof sections below main roof are in need of major repairs or
(6) Other			✓	Equipment on gravel built up roof sections are not secure. Metal coping is rusting

SPECIAL CONCERNS	
Are there any special concerns in the event of high winds or heavy rain that need to be addressed?	East end of roof has holes and temporary repairs. Must be repaired at once. I strongly recommend replacing this roof system due to the amount of damage that has occurred. Integrity of this roof system has been severly compromised.
SPECIAL COMMENTS	
Please note any special comments.	Repair all holes, complete perminent patches, seal open laps, repair east end of the roof metal and membrane. These repairs will eliminate further water intrusion and possible damage to metal decking and insulation
TENANT LIST	
Please list any tenant that did not have proper unit attachment.	
INSPECTOR:	Bill Fortin

	Deficiency		Solution	Photo
1	Exterior damage to metal fascia, siding and coping			
	Deficiency		Solution	Photo
2	Exterior damage to coping			
	Deficiency		Solution	Photo
3	Metal coping under screen wall damaged			

	Deficiency		Solution	Photo
4	Main roof overview			
	Deficiency		Solution	Photo
5	Main roof overview			
	Deficiency		Solution	Photo
6	Main roof overview			

	Deficiency		Solution	Photo
7	Improperly installed fasteners in field seam		Install new PVC membrane over area. Recommend replacing roof system.	

	Deficiency		Solution	Photo
8	Lightning arrester system severely damaged		Entire system should be replaced and properly attached to roof by a licensed contractor	

	Deficiency		Solution	Photo
9	Patches installed throughout roof system were not installed with Firestone PVC material peel and stick and caulking was used		Remove all temp repairs made during Irma and install new PVC patches	

	Deficiency		Solution	Photo
10	Temp repair made with caulking		Remove caulking and install new PVC membrane over area	
	Deficiency		Solution	Photo
11	Fasteners installed at edge of the field seam rusting out. Seam not secure.		One of many compromised areas. Temporarily patch with new PVC membrane. Suggest replacing roof system.	
	Deficiency		Solution	Photo
12	Hole in membrane		Install new PVC patch	

	Deficiency	Solution	Photo
13	Open laps	Probe all laps and repair with new PVC membrane	
	Deficiency	Solution	Photo
14	Open field laps	Probe all laps and repair with new PVC membrane	
	Deficiency	Solution	Photo
15	Loose patch	Remove existing patch and install a new PVC patch	

	Deficiency		Solution	Photo
16	Cut in membrane. Insulation saturated.		Remove wet insulation in areas affected and install new PVC membrane. Recommend replacing roof system.	
	Deficiency		Solution	Photo
17	Open laps and rusted fasteners		Roof system is compromised in these areas. Temp fix patch with new PVC membrane. Permanent fix is to replace roof system.	
	Deficiency		Solution	Photo
18	Loose patches		Remove loose patches and install new PVC membrane patches	

	Deficiency		Solution	Photo
19	Open laps		Repair with new PVC membrane	
	Deficiency		Solution	Photo
20	Clad drip edge metal missing and loose membrane and perimeter sheet not secured			
	Deficiency		Solution	Photo
21	Holes in the membrane		Repair with new PVC membrane to prevent further damage to roof insulation	

	Deficiency		Solution	Photo
22	Fasteners have uplifted due to hurricane Irma		Remove and replace roof system	
	Deficiency		Solution	Photo
23	Temp repairs with caulking		Remove all temporary repairs and repair with new PVC membrane	
	Deficiency		Solution	Photo
24	Open field laps throughout roof system		Probe all laps and repair with new PVC membrane	

EXHIBIT 7B
BUILDING ENVELOPE FORENSICS, BY G.F. MARON, PE STRUCTURAL ENGINEERING

EXHIBIT F
DESIGN CRITERIA PACKAGE

June 27, 2018

Lee County Board of County Commissioners
Division of Purchasing
P.O. Box 398
Ft. Myers, FL 33902-0398

Attn: Ehab B. Guirguis P.E., Director Facilities
Construction and Management

Subject: Roof Inspection
Germain Arena
11000 Everblades Parkway
Estero, FL 33928

Dear Mr. Guirguis,

On June 12, 2018, Mr. Bill Fortin of West Coast Enterprises and I examined the main roof of Germain Arena. This included the domed roof over the Everblades Hockey Rink and the adjacent flat roof. These two roofs cover a multi-purpose area that is also used as a hurricane evacuation shelter by Lee County's Emergency Operations. The purpose of this examination is three-fold: first, to determine the condition of these roofs and second, to provide an opinion as to the suitability of Germain Arena as a hurricane evacuation shelter in its present condition and third, to recommend required repairs.

The roofs were visually inspected from grade and from on top of the roofs. No testing was performed. The roof structure was examined from the suite level walkway. Mr. Fortin and I were informed by Arena Management that moisture testing had been performed on the roof and that the underlying insulation was found to be wet. We were told that temporary emergency repairs were performed after Hurricane Irma. I have reviewed West Coast Enterprises Roof Inspection 2018, which is attached. I agree with West Coast Enterprises' report in its entirety.

The purpose of this letter is to act as a summary to the West Coast Enterprises' Roof Inspection 2018. Please refer to that report for a more detailed analysis.

<u>SUMMARY</u>

Germain Arena first entered the tax rolls in 1998. The roof in place appears to be the original roof. Over the domed area, the roof is Firestone PVC. The adjacent flat roofs are gravel ballasted, built-up roofs.

Both of these roofs are at the end of their projected service life. It appears that very little maintenance has been performed to date on both roofs in order to extend their service life. Additionally, the mechanical equipment that is located on the flat roofs is in poor condition. Structural supports and fasteners to the roof are severely corroded.

Hurricane Irma caused substantial damage to the dome roof. There are numerous tears and openings at lap splices on the roof. There is a significant amount of this kind of damage on the southwest quadrant of the roof.

The upper east facing wall of the arena sustained the greatest damage during the storm. Along the gable wall, siding and drip edge is missing.

Stained ceiling tile was found in the hallways on the suite level. This is an indication that the roof is leaking.

As noted above, temporary emergency repairs were performed shortly after Hurricane Irma. While these actions may have stopped active leaks, they were little more than Band-Aids meant to buy time until actual repairs could be made. Tears and lab joints were patched with peel and stick polymer patches. This is not compatible with the PVC roofing. The east facing wall was patched with plastic sheeting, self-adhering roofing paper (peel and stick) and bent metal. None of these patches are in keeping with the original design specifications for these roofs.

The lightning arresting system was damaged during the storm. It is non-functional in its current condition.

Base on the interior examination, there is no damage to the roof structure or decking.

See attached detail photographs.

<u>CONCLUSION</u>

Both of these roofs are in failure mode. Active leaks have either appeared or will appear shortly. The dome roof may be stripped off the decking by strong winds from the east or south west. The dome roof is susceptible to failure in a tropical storm. A strong summer afternoon summer storm may cause significant damage. If the roof is stripped from the deck during a storm, the entire hockey rink area will be saturated.

If this arena is to be used as an evacuation shelter, both the entire dome roof and the adjacent flat roofs must be removed and replaced. Both roofs are in such poor condition that no amount of repairs will bring them up to the standards required for a shelter during the current hurricane season.

Should you have any questions or require any additional information, please do not hesitate to contact me directly at 239.287.3565.

Very truly yours,

Gerard F. Maron, P.E.
FL. PE #61298

GERARD F MARON
LICENSE
No. 61298
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

EXHIBIT F
DESIGN CRITERIA PACKAGE

EAST FACE OF GERMAIN ARENA
SEE CLOSE UPS BELOW

TEMPORARY REPAIR

EXHIBIT F
DESIGN CRITERIA PACKAGE

TEMPORARY REPAIR

TEMPORARY REPAIR

EXHIBIT F
DESIGN CRITERIA PACKAGE

FLAT ROOF

CORRODED PARAPET CAP

EXHIBIT F
DESIGN CRITERIA PACKAGE

LOOSE EQUIPMENT ON FLAT ROOF

DAMAGED LIGHTNING ARRESTING SYSTEM

EXHIBIT G

DESIGN AND CONSTRUCTION SCOPE (TBD BASED ON PHASE 1)

Walker Contracting Group
CGC 061008

TRC
WORLDWIDE ENGINEERING

Exhibit "G"
Scope of Work & Fees for Phase 1
Germain (Renamed Hertz) Arena

SUMMARY OF ENGINEERING SCOPE OF WORK:
Based upon requirements provided in RFQ, above noted potential deficiencies, and Florida Building Code requirements, see below itemized summary of the engineering scope of work. The scope of work has been delineated into specific tasks: **A** - Field Work, **B** - Analysis of Existing Structure and Envelope Systems, **C**- Preparation of Report.

Phase 1 Fee Not to Exceed $229,751.00

HOURLY RATES:

Project EOR and SI	PE - Project Manager	Designers (EIT)	Threshold Inspector	CAAD Manager	CAAD Designers
$218.40	$151.20	$117.60	$89.60	$89.60	$78.40

WCG - Project Director	WCG Sr. Project Manager	WCG Field Mechanics
$150.00	$135.00	$65.00

A: Field Work

1) Obtain from Lee County Building Depart all of the permit documents that exist for this facility. Review existing drawings, permit documents, Lee County Facility documents, and engineering reports of existing facility.
2) Preparation by engineer and contractor for site observations
    a. Prepare roof plans for field use, structural plan and roof plan – use existing plans
    b. Prepare building elevations for fenestrations for field use – use existing plans
3) Observe and document existing structural conditions
4) Observe and document termination points of metal siding for flashing considerations
5) Observe from ground each existing exterior fenestration (windows, doors, louvers, storefronts, etc) and compare with existing plans. Attempt to identify glazing type from any window marks.
6) In a lift, measure several different steel roof joist in the dome roof area only. Record existing steel joist panel point spacing, joist length, size and thickness of top and bottom chords, size and thickness of joist webs. Spacing, size, and location of joist bridging. Record size and length of weld of joist connection to structure at one end of each steel joist to be field measured as described above. These connections are obscured, so accurate measurements may not be technically feasible.

7) During truss observations, attempt to ascertain current roof deck connection to trusses, either puddle welds, by burn marks, or TEK screws.
8) Observe and field measure at 4 to 5 locations, from lift, existing steel girder truss member sizes, thickness, truss depth, and panel point spacing to compare with existing structural drawings.
9) Measure and document connections of steel beams to truss girders and connections of girders to concrete columns at 4 to 5 locations to compare with existing structural drawings
10) Observe and document conditions of wall waterproofing, and sealants on exterior envelope as can be observed from the ground.
11) Perform non-destructive testing and observations of exterior masonry walls at random locations to confirm spacing of vertical reinforcing using a hand-held metal detector and mechanical sounding. Also verify masonry wall thickness where possible at openings.
12) Observe, field measure, and document each existing exterior fenestration (windows, doors, louvers, storefronts, etc) and document existing jamb header and sill construction as applicable. Perform non-destructive testing and limited demolition as required to document above. NOA's and product approvals have minimum requirements of host structure. A lift will be required for this work.
13) For each different steel roof joist, as deemed appropriate for calculating existing uplift capacity, from a lift, record existing steel joist panel point spacing, joist length, size and thickness of top and bottom chords, size and thickness of joist webs. Spacing, size, and location of joist bridging. Record size and length of weld of joist connection to structure at one end of each steel joist to be field measured as described above. These connections are obscured, so accurate measurements may not be technically feasible.
14) During truss observations, attempt to ascertain current roof deck connection to trusses, either puddle welds, by burn marks, or TEK screws.
15) Measure and document connections of steel beams to truss girders and connections of girders to concrete columns at 3-5 locations to compare with existing structural drawings
16) Observe and document conditions of paints, coatings, and sealants on exterior envelope. Testing will include peal tests, measurement of existing paint dry film mill thickness on various exterior finishes.
17) TRC will observe from ground stucco to determine extent of delaminated stucco if any and record approximate location and size on elevations.

B - <u>ANALYSIS OF EXISTING STRUCTURE AND ENVELOPE SYSTEMS</u>

1) Review wind load requirements and rainwater design criteria for the facility based upon reference standards and use of facility and establish design criteria to be approved by Lee County for use in analysis and design.
2) Build analytical model of existing structure and all structural building elements including Main Wind Force Resisting Systems (MWFRS) using ETABS. Model will be used for verification of existing MWFRS for specified wind criteria, obtaining foundation loads for verification of existing foundations, and verification of design of steel beams and roof girders. If deficiencies are determined, perform design as required to strengthen existing structure.
3) Verify diaphragm capacity for MWFRS include combinations of wind uplift with diaphragm shear loads and review of diaphragm chords, continuity, load paths, and collectors.

4) Verify connections of trusses and girders to structure for uplift.
5) Verify existing foundations with loads from analytical model.
6) Perform calculations to check existing capacity of exterior wall systems including reinforced masonry walls, concrete beams and columns used as lateral support of walls, and cold formed steel studs including connections to structure.
7) Verify capacity of jambs, headers, and sills for new fenestrations.
8) Perform finite element analysis of each of the steel roof joists measured to verify existing capacity and design strengthening where required.
9) Analyze exterior siding connections including sheathing and waterproofing condition below siding and design additional required support and new metal siding.
10) Verify size, slope of roofing, and existing drains based upon established rainwater criteria.
11) Attempt to locate NOA's or Florida Product Approvals for existing Fenestrations. If not available, perform calculations for glass wind load capacity using ASTM E1300 and compare to calculated design pressures. It may be necessary to provide results for several different glass thicknesses if thickness is not readily determined from information provided. TRC will NOT perform missile testing, ASTM E-1886 and ASTM E-1996, Level E, as stipulated in RFP as this is not an appropriate test for installed glazing. TRC will attempt to locate records of existing glazing to determine if they are impact resistant.

C – PREPARATION OF REPORT

1) Create photo exhibit with notes.
2) Draft as-built roof plan with existing roof mounted equipment.
3) Add location of cores to roof plan and include summary of findings at each core.
4) Summarize observations of Cold Formed Stud (CFS) framing size, spacing, and connections including metal siding attachments, sheathing, and any other supporting structures for CFS walls.
5) Summarize observations of masonry walls and results of non-destructive testing.
6) Create summary of fenestration observations with documented notes on structural support of jambs, headers, and sills.
7) Prepare summary of measurements of steel trusses and girders with elevations and connection details.
8) Based upon analysis from B – Analysis of Existing Structure and Envelope Systems, provide a summary of deficiencies including preliminary conceptual repair recommendations.
9) Prepare elevations with approximate locations and square footages of delaminated stucco.
10) Working with Walker establish repair costs for each noted deficiency.
11) Report will also address requirements noted in RFP.

EXHIBIT H

DESIGN-BUILD FIRM PROJECT PERSONNEL ROSTER

EXHIBIT "H"
GERMAIN (RENAMED HERTZ) ARENA
DESIGN-BUILD FIRM DESIGN PHASE PERSONNEL ROSTER

WALKER CONTRACTING GROUP
DESIGN PHASE INVOLVEMENT

Jason Swanson / Project Director
Role is to be main contact between the owner and the construction group. Delegates key duties to project manager and construction manager. Prepares, maintains and updates project schedule showing start dates, durations and completion dates for all line item scopes of work. Understanding owner and design team requirements and all facets of the project. Review of all submittals with Sr. Project Manager and clerk. Executing all contracts and documents relevant to project. Initiates timely requests for prior approval for changes when required (e.g. change in scope of work, re-budgeting, or reduction in committed effort). Ensures accurate and timely effort reporting for project personnel. Initiates the routing and obtains appropriate approvals prior to proposal submission. Assists with negotiation of award terms as needed. Monitors project's financial status. Manages project within budget limits. Seeks prior approval for budget changes when required. Approves sub-recipient agreements and related invoices. Ensures that cost-share requirements are met. Reviews final financial statements.

Michael Walker / Co-Project Director
Role is to be supplemental contact between the owner and the construction group as well as oversees all management tier personnel.

Stephen Bauer / Senior Project Manager
Role is to report to Project Director and coordinate with Construction Manager. Solicits and engages subcontractors for specialized trade scopes. Submits requests for information to resolve issues arising during construction phase. Prepares change orders for compensation of unforeseen contingencies as well as technical submittals for engineer's approval. Responsible for advance procurement of high-performance materials with consideration to lead time. Tracks monthly progress to prepare applications for progress payments. Risk analysis, managing risks and issues.

TRC WORLDWIDE ENGINEERING
DESIGN AND CONSTRUCTION PHASE INVOLVEMENT

Paul Moerschel, P.E., S.I.
As Project Director and Principal-in-Charge, Mr. Moerschel will provide leadership and direction to the TRC project team, and executive oversight for the project from the initial negotiations phase through development, design and construction.

Paul outlines deadlines, project status, staffing assignments and quality control review to keep projects on schedule and on budget. He will regularly review each to insure and maintain the proper level of quality.

Robert Algoo, E.I.
As Project Manager, Robert will be the main contact for the project. He will perform analysis of the structure; observations and detailed report of his findings, prepare working drawings and specifications, and after approval by Lee County, will proceed with the Construction Phase.

Richard Algoo, E.I.
As Project Engineer, Richard will work closely with Robert during all Phases of the Approach. In addition, he will review data for material used by the Contractor, review requests for payment, periodic observation of work in progress, and other legal documentation to ensure all paperwork is properly handled.

Kathy Iskander
Mrs. Iskander will work closely with team members to produce quality Contract Documents with cutting edge Revit Structure (BIM) as well as AutoCad.

Other Mainly Design Phase Involvement:
Francisco Moncada, EIT
Matt Maltezos
Edward Iskander, CAD Operator
Darlene Bailey, CAD Operator

EXHIBIT I

SUPPLEMENTARY CONDITIONS

EXHIBIT "I"

SUPPLEMENTARY CONDITIONS

[RESERVED]