Florida City Gas

**Jason A. Higginbotham, Esq.**
**Senior Attorney**
**On behalf of Florida City Gas (LAW/JB)**
**700 Universe Blvd.**
**Juno Beach, FL 33408-0420**
**Direct: (561) 691-7108**
**Fax: (561) 691-7135**
**E-mail: jason.higginbotham@fpl.com**

January 14, 2022

**VIA ELECTRONIC FILING**
Mr. Adam Teitzman
Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

**Re: Rule 25-7.0143(1)(l), Florida Administrative Code, Storm Damage Self-Insurance Reserve Study, Florida City Gas**

Dear Mr. Teitzman:

Pursuant to Rule 25-7.0143(1)(l), Florida Administrative Code, a copy of the Storm Damage Self-Insurance Reserve Study for Florida City Gas is enclosed with this letter.

Please contact me at (561) 691-7108 if you or your Staff has any questions regarding this submission.

Sincerely,

/s/ Jason A. Higginbotham
Senior Attorney

enclosure

January, 2022

# Florida City Gas

## Hurricane Cost and Reserve Performance Analyses

ABS Consulting Project Number: 4697507



300 Commerce Drive, Suite 150 • Irvine, CA 92602, USA • (714) 734-4242 • FAX (714) 734-4272

FCG 000467
20220069-GU

# Executive Summary

The Florida City Gas (FCG) system is exposed to and in the past has incurred significant costs from hurricanes. After hurricane events, FCG is required to respond to reported safety hazards such as gas leaks and blowing gas lines, and to perform damage assessments of the FCG system. The exposure to these potential hurricane costs are modeled and quantified.

Two analyses were performed. A Hurricane Cost Analysis was performed using a computer catastrophe simulation model that estimates the average annual costs from hurricane perils. A Reserve Performance Analysis was performed using a dynamic financial simulation model to estimate the performance of the reserve subject to the annual hurricane cost probabilities determined in the Cost Analysis

The hurricane exposure is analyzed from a probabilistic approach. The model simulates a large number of hurricane events, covering the full range of potential hurricane characteristics, and determines their corresponding costs. Factors considered in the analysis include the location of FCG's customers, the probability of hurricanes of different intensities and landfall points impacting those customers, the vulnerability of those customers to hurricane damage, and the costs to perform post hurricane inspection assessment activities.

The frequencies and computed costs for a large set of simulated hurricanes are combined to calculate the expected annual cost and the annual aggregate exceedance relations. The expected annual cost represents the average of all hurricane years over a long period of time.

There is an approximate 10% probability that inspection costs from all hurricanes in one year could exceed $600,000, and a 1% probability that costs could exceed $2,500,000.

The Reserve Performance Analysis simulates the performance of FCG's reserve fund over a five-year prospective period and is based on the probabilistic derived costs and frequencies of occurrence of hurricanes as determined in the Cost Analysis.

The analysis provides two cases that assume negative reserve balances due to hurricane costs are:

1. Not recovered within the five-year simulation, or are
2. Recovered in one (1) year after the hurricane within the five-year simulation.

The analysis case with no recoveries of negative reserve balances shows the reserve fund balance is expected to decline from the initial $143,000 to a negative ($624,000) at the end of five years. There is a 65.9% probability that the reserve could have inadequate funds to cover hurricane costs in one or more years of the five-year simulation.

The analysis case with one (1) year recovery of negative reserve balances shows the reserve fund balance is expected to decline from the initial $143,000 to a negative ($77,500) at the end of five years. There is a 65.5% probability that the reserve could have inadequate funds to cover hurricane costs in one or more years of the five-year simulation.

A summary of the analyses performed of FCG's hurricane cost exposure and reserve performance are provided in the risk profile shown in Table E-1 below.

**Table E-1**

**Florida City Gas Risk Profile**

| | | |
|---|---|---|
| **OWNER** | **Florida City Gas** | |
| **COSTS** | "Make Safe" customer service inspections, damage assessments of the FCG system, and repairs. | |
| **LOCATION** | All located within the State of Florida | |
| **PERILS** | Hurricanes, Categories 1 to 5 | |
| | **Hurricane Cost Analysis** | |
| **EXPECTED ANNUAL COST** | $190,000 | |
| **1% AGGREGATE COST EXCEEDANCE VALUE** | $2,500,000 | |
| | **Reserve Performance Analyses** | |
| $143,000 Initial Balance, and Annual accrual of $57,500 | Mean (Expected) Balance at 5 years | 5th Percentile Balance at 5 years |
| No Recovery of Negative Reserve Balances | Negative ($624,000) | Negative ($3,059,000) |
| One (1) year Recovery of Negative Reserve Balances | Negative ($77,500) | Negative ($1,266,000) |

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## Tables



## Figures

# 1. Hurricane Cost Analysis

The Florida City Gas (FCG) system is exposed to and in the past has incurred significant costs from hurricanes. After hurricane events, FCG is required to respond to reported safety hazards such as gas leaks and blowing gas lines, and to perform damage assessments of the FCG system. The exposure to these potential hurricane costs is quantified. A Cost Analysis was performed using the CoreLogic computer model simulation program *Risk, Quantification and Engineering (RQE®)* as well as the portfolio data of customer locations provided by FCG.

Hurricane exposure is analyzed using a probabilistic approach, which considers the full range of potential hurricane characteristics and corresponding costs. Probabilistic analyses identify the probability of damage to customer premises and the cost of performing “Make Safe” inspections.

Probabilistic annual costs are computed using the results of over 110,000 hurricane events. Annual cost estimates are developed for each simulated hurricane due to damage at individual customer premise locations and aggregated to provide overall portfolio cost amounts.

Factors considered in the analyses include the location of FCG’s customers, the probability of hurricanes of different intensities and/or landfall points impacting those assets, the vulnerability of those customer premises to hurricane damage, and the costs to inspect customers and FCG system assets.

## Hurricane Estimation Methodology

The basic components of the hurricane risk analysis include:

- **Customer Locations at Risk:** Define and locate
- **Hurricane Hazard**: Apply a probabilistic hurricane model for the region
- **Customer Vulnerabilities:** Severity (wind speed/storm surge) versus damage and inspection cost
- **Portfolio Analysis:** Probabilistic analysis based on aggregate inspections and associated costs

These analysis components are summarized herein.

# 2. Post Hurricane Customer Service, and System Inspection Costs

## Customer Locations at Risk

After hurricane events, FCG is required to respond to reported safety hazards such as gas leaks and blowing gas lines. These emergency leak orders require FCG to conduct leak surveys, disconnect and reconnect customers, cut and cap service lines, remove meters, and replace damaged facilities.  FCG field staff also performs damage assessments of the FCG system after significant hurricane events.

FCG's customer premises are distributed unevenly across its Florida service territory. FCG provides service to approximately 116,000 customers premises located in Miami Dade, Brevard, Indian River, Saint Lucie, and, Martin Counties. The FCG customer premises are geo-located located in the RQE hurricane model to capture the spatial distribution and concentration of these customer premises and their vulnerability to hurricane and storm surge risk.

# 3. Hurricane Hazard in Florida

The historical record for hurricanes on the Gulf and Atlantic coasts of the United States consists of over 100 years for which reasonably accurate information is available. Historically, approximately 500 tropical or subtropical cyclones have affected the state of Florida. Since 1900, there have been 29 hurricanes of Saffir-Simpson Intensity (SSI) 3 or greater (see Table 3-1 for description of the Saffir-Simpson Intensity scale) which have made landfall in the state of Florida. Going back further, written descriptions of hurricanes are available, but it becomes increasingly difficult to estimate actual hurricane intensities and track locations in a reliable manner consistent with the later data. For this reason all hypothetical hurricanes used in this analysis, as well as their corresponding frequencies, have been based only on hurricanes that have occurred since 1900.

Since the historical record is too sparse to simply extrapolate future hurricane landfall probabilities, a series of hypothetical hurricanes was generated in the RQE probabilistic hurricane data base, essentially “filling in” the gaps in the historical data. This provides an estimate of future potential hurricane locations (landfall), track, severity and frequency consistent with the observed historical data.

The hurricane model was developed (Reference 1), using the National Oceanic and Atmospheric Administration (NOAA) model as the base, to determine individual hurricane wind speeds. The NOAA model was designed to model only a few specific types of hurricanes. While the eye of the hurricane follows the selected track, the model uses up to a dozen different hurricane parameters to estimate wind speeds at all distances away from the eye. RQE is based in part on the Florida Commission on Hurricane Loss Projection Methodology’s Official Storm Set, which includes hurricanes affecting Florida during the period of 1900 to 2017.

The hurricane intensities used for the analyses conform to basic NOAA information regarding hurricane intensity recurrence relationships corresponding to locations along the coast. Much of FCG’s service territory includes coastal areas where these hurricanes have made landfall.

The historical annual frequency of hurricanes has varied significantly over time. There are many causes for the temporal variability in hurricane formation. One of the primary climate cycles having a significant correlation with hurricane activity is the Atlantic Multidecadal Oscillation (AMO). It has been suggested that the formation of hurricanes in the Atlantic Ocean off the coast of Africa is related to the amount of rainfall in the Western African Sahel region. Years in which rainfall is heavy have been associated with the formation of a greater number of hurricanes. The AMO cycle consists of a warm phase, during which the tropical and sub-tropical North Atlantic basins have warmer than average temperatures at the surface and in the upper portion relevant to hurricane activity, and a cool phase, during which these regions of the ocean have cooler than average temperatures. In the period of 1900 to the present, the AMO has gone through the following phases:

| | | |
|---|---|---|
| 1900 to 1925 | Cool | (Decreased Hurricane Activity) |
| 1926 to 1969 | Warm | (Increased Hurricane Activity) |
| 1970 to 1994 | Cool | (Decreased Hurricane Activity) |
| 1995 to the Present | Warm | (Increased Hurricane Activity) |

These AMO phases are illustrated by the plot of Sea Surface Temperature (SST) Anomalies (deviation from the mean) in the Atlantic Basin over the past 150 years in Figure 3-1.

The NOAA believes that we entered a warm phase of AMO around the mid-1990s which can be expected to continue for at least several years. Historically, each phase of AMO has lasted approximately 20 to 40 years.

Probabilistic Annual Cost is computed using the results of thousands of random variable hurricanes considering the current Near-Term warm period of hurricane hazard.

**Table 3-1**

**The Saffir-Simpson Intensity Scale (SSI)**
**(Note That Windspeeds Given Are 1-Minute Sustained)**

| SSI | Central Pressure (mb) | Maximum Sustained Winds (mph) | Storm-Surge Height (ft) | Damage |
|---|---|---|---|---|
| 1 | ≥ 980 | 74-95 | 4-5 | Damage mainly to trees, shrubbery, and unanchored mobile homes |
| 2 | 965-979 | 96-110 | 6-8 | Some trees blown down; major damage to exposed mobile homes; some damage to roofs of buildings |
| 3 | 945-964 | 111-130 | 9-12 | Foliage removed from trees; large trees blown down; mobile homes destroyed; some structural damage to small buildings |
| 4 | 920-944 | 131-155 | 13-18 | All signs blown down; extensive damage to roofs, windows, and doors; complete destruction of mobile homes; flooding inland as far as 6 mi.; major damage to lower floors of structures near shore |
| 5 | < 920 | > 155 | > 18 | Severe damage to windows and doors; extensive damage to roofs of homes and industrial buildings; small buildings overturned and blown away; major damage to lower floors of all structures less than 15 ft. above sea level within 500m of shore |

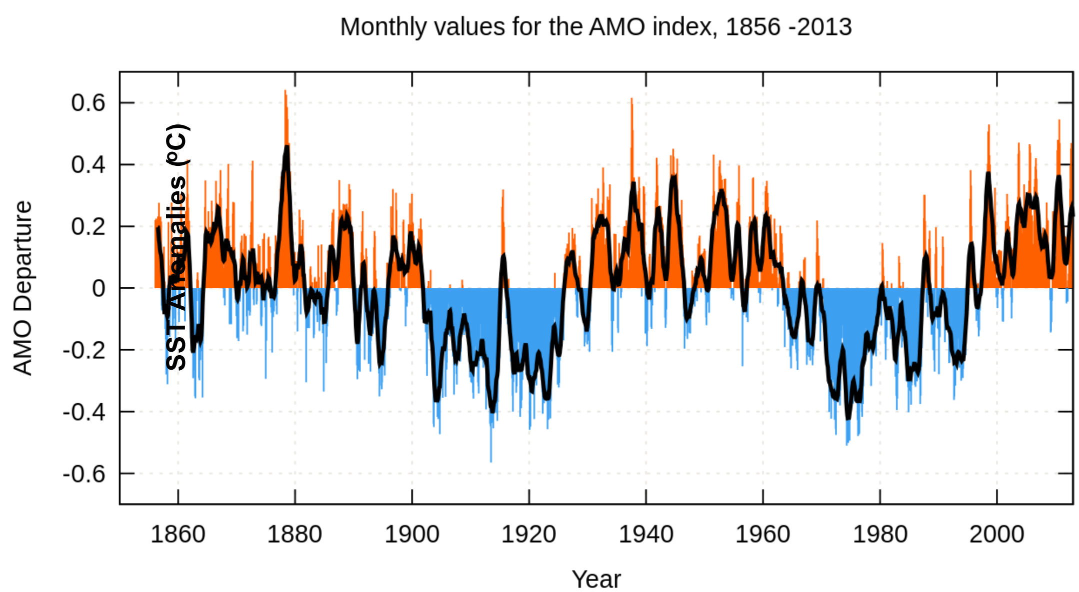


Figure 3-1: Atlantic Multidecadal Oscillation index computed as the linearly detrended North Atlantic sea surface temperature anomalies 1856-2013.



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## Storm Surge Analyses

The storm surge hazard model is supported by the same stochastic hazard event set within *RQE* to develop wind field and hurricane parameter descriptions, and is additionally integrated with bathymetry data at the Atlantic coastline of the United States from Canada to Mexico.

The phenomenon of storm surge is mainly caused by the wind stress towards the coastline from an approaching tropical cyclone and the atmospheric pressure depression. The main parameters inducing storm surge along the coast are peak gust wind, bathymetry (shallowness), rotation of the earth (Coriolis force), waves and pressure gradient developed in the Tropical Cyclone.

In surge phenomenon, the wind stress coefficient has been identified as the dominant parameter among various model and shelf parameters, because of the stress from the tangential component of the wind, which provides the main driving force for the surge.

The US coast is divided into five zones and bathymetry data has been digitized from coastal Texas to Maine. Grids have been constructed all along the coast in the ocean shelf. The important inputs to the model are the bathymetry of the region at these grid points and cyclone data. The model uses the finite element method to simulate the surge flow by solving vertically an integrated form of shallow water gravity equations. The surge model provides a best estimate of the height of storm surge at the coastal interface.

The model solves the equations of motion for the near-shore sea water, including the wind stress from the standard *RQE* wind field model and the bottom stress as boundary conditions. The bathymetry (ocean depth) is defined on a grid, and the equations of motion are numerically solved at each nodal point of the grid, resulting in the peak storm surge height at a series of coastal boundary points.

For each hurricane event, the probabilistic distribution of storm surge inundation depth is calculated for each location in the portfolio, using the probabilistic distributions of all important storm and location parameters. Inundation is modeled in two zones: the high-velocity zone (typically the first few hundred meters from the coast), where wave action and debris can severely damage structures, and farther inland, where the main problem is flooding as opposed to structural damage. For each hurricane event, the width of the high-velocity zone is calculated at each coastal boundary point using a run-up model. The elevation of the storm surge water surface farther inland is a function of the surge height at the coast and the local distance to the coast.

The storm surge model is run for the probabilistic event set to compute the storm surge at the portfolio asset location. The frequency of each event with the storm surge is calculated.

# 4. Customer Vulnerabilities

Structures have suffered damage in past hurricanes. Structure damage patterns tend to be most severe in coastal areas where buildings can be exposed to both wind and storm surge perils. Damage at inland locations tends to be less severe with contributions to damage from only wind perils. Structure damage varies with hurricane wind speeds and depths of storm surge. Damage to structures has in past hurricanes resulted in damage to gas lines, meters, and to other equipment that has required FCG inspection to ensure safe conditions.

Vulnerability of customer premises is based upon typical Florida construction, modeled wind speeds, and storm surge from simulated hurricanes. FCG data on the cost of "Make Safe" inspections and costs to inspect system assets are utilized in the modeling of hurricane costs. FCG's cost data from the 2016 Hurricane Matthew and 2017 Hurricane Irma provide data on recent hurricane costs from moderate to strong intensity events. These hurricane cost experiences include the effects of many factors including the post hurricane costs of labor, fleet equipment, and accommodations associated with the hurricane inspection processes utilized by FCG.

# 5. Hurricane Cost Analysis Results

FCG's customer premise locations were analyzed using the proprietary computer program, *RQE,* subject to a suite of probabilistic hurricanes. The probabilistic hurricane analyses provide the expected annual costs, and non-exceedance probabilities over a range of cost levels.

## Storm Probabilistic Analysis

The probabilistic cost analysis is performed using RQE. The hurricane hazard uses the RQE probabilistic stochastic hurricane database which contains approximately 110,000 simulations of possible hurricanes affecting the eastern United States, along both the Gulf and the Atlantic coasts. Each hurricane in the database has been defined by associating a central pressure with a unique hurricane track. In addition, each hurricane is assigned an annual frequency of occurrence, which depends on the hurricane track location and the hurricane intensity as measured by central pressure. For each customer location in the portfolio, the wind speed is calculated, the degree of structure damage and the inspection cost is estimated. The sum of the cost for each customer location is an estimate of the mean cost for each hurricane simulation.

### Aggregate Cost Exceedance and Expected Annual Cost

Aggregate cost exceedance calculations are developed by keeping a running total of costs from all possible events in a year. At the end of each year, the aggregate cost for all events is then determined by probabilistically summing the cost distribution from each event, taking into account the event frequency. The process considers the probability of having zero events, one event, two events, etc. during a year.

A series of probabilistic analyses were performed, using the vulnerability curves derived for FCG's customer locations in RQE. A summary of the analysis is presented in Table 5-1, which shows the aggregate cost exceedance probability for cost layers between $0 and more than $2,500,000.

For each cost layer shown, the probability of cost exceeding a specified value is shown. For example, the probability of costs exceeding $200,000 in one year is 20.3%. The analysis calculates the probability of costs from all hurricanes and aggregates the total cost and exceedance probabilities.

The expected annual cost (EAC) from hurricanes is $190,000. This value represents the average cost from all simulated hurricanes. The EAC is not expected to occur every year. Some years will have no costs from hurricanes, some years will have small costs, and a few years will have large cost. The EAC represents the average of all hurricane years over a long period of time.

Table 5-1

**FLORIDA CITY GAS**
**AGGREGATE COST EXCEEDANCE PROBABILITIES**

| Damage Layer ($x1,000) | 1 Year Exceedance Probability |
|---|---|
| > 100 | 27.8% |
| 200 | 20.3% |
| 300 | 16.9% |
| 400 | 13.9% |
| 500 | 11.9% |
| 600 | 9.99% |
| 700 | 8.59% |
| 800 | 7.39% |
| 900 | 6.48% |
| 1,000 | 5.68% |
| 1,100 | 4.99% |
| 1,200 | 4.39% |
| 1,300 | 3.85% |
| 1,400 | 3.43% |
| 1,500 | 3.02% |
| 1,600 | 2.73% |
| 1,700 | 2.45% |
| 1,800 | 2.17% |
| 1,900 | 1.94% |
| 2,000 | 1.78% |
| 2,100 | 1.63% |
| 2,200 | 1.47% |
| 2,300 | 1.32% |
| 2,400 | 1.16% |
| 2,500 | 1.01% |

# 6. Reserve Performance Analysis

A dynamic financial analysis of potential costs from hurricanes was performed to determine their impact on the performance of FCG's reserve. The analysis included the costs from all simulated hurricane events.

The expected annual cost from the hurricane Cost Analysis is $ 190,000. The expected annual cost estimate represents the average annual cost associated with hurricane inspections for service restoration over a long period of time.

**Analysis**

The Reserve performance analysis consisted of performing 10,000 iterations of hurricane cost simulations within the FCG service area, each covering a 5-year period, to determine the effect of the costs on the FCG Reserve. Monte Carlo simulations were used to generate cost samples for the analysis. The analysis provides an estimate of the Reserve assets in each year of the simulation, accounting for the annual accrual, borrowing costs when fund balances are negative, and hurricane costs, as determined in the Cost Analysis, using a dynamic financial model.

The analysis provides estimates of the fifth percentile and ninety-fifth percentile reserve balances. At the fifth percentile reserve balance, only five percent of the simulated outcomes have smaller values. Similarly, for the ninety-fifth percentile reserve balance, only five percent of simulated outcomes have values which would be greater than that value. The fifth percentile represents an extremely adverse five years of hurricane experience where costs would far exceed the reserve funds available.

**Assumptions**

The analysis performed included the following assumptions:

- An initial Reserve balance of a $143,040.
- Expected Annual Cost from hurricane hazard is $190,000.
- An annual accrual of $57,500 each year.
- The reserve balance has a maximum balance of $800,000.

- Two cost recovery cases for negative reserve balances were analyzed:
  - No cost recovery within the five (5) year simulation, and
  - A one (1) year recovery period for negative reserve balances.
- Hurricane costs were assumed to increase by 5% per year; 3% per year due to inflation, and 2% per year due to system growth.
- Negative reserve balances were assumed to be financed with an unlimited line of credit costing 1.4%.

**Analysis Results**

Reserve analyses were performed for two cases. The results show the annual reserve accrual amount, the mean (expected) reserve fund balance as well as the probability that the reserve fund balance will be negative in any one or more of the five years of the simulated time horizon.

The analysis case with no recoveries of negative reserve balances shows that the reserve fund balance is expected to decline from the initial $143,000 to a negative ($624,000) at the end of five years. There is a 65.9% probability that the reserve could have inadequate funds to cover hurricane costs in one or more years of the five-year simulation.

The analysis case with one (1) year recovery of negative reserve balances shows the reserve fund balance is expected to decline from the initial $143,000 to a negative ($77,500) at the end of five years. There is a 65.5% probability that the reserve could have inadequate funds to cover hurricane costs in one or more years of the five-year simulation.

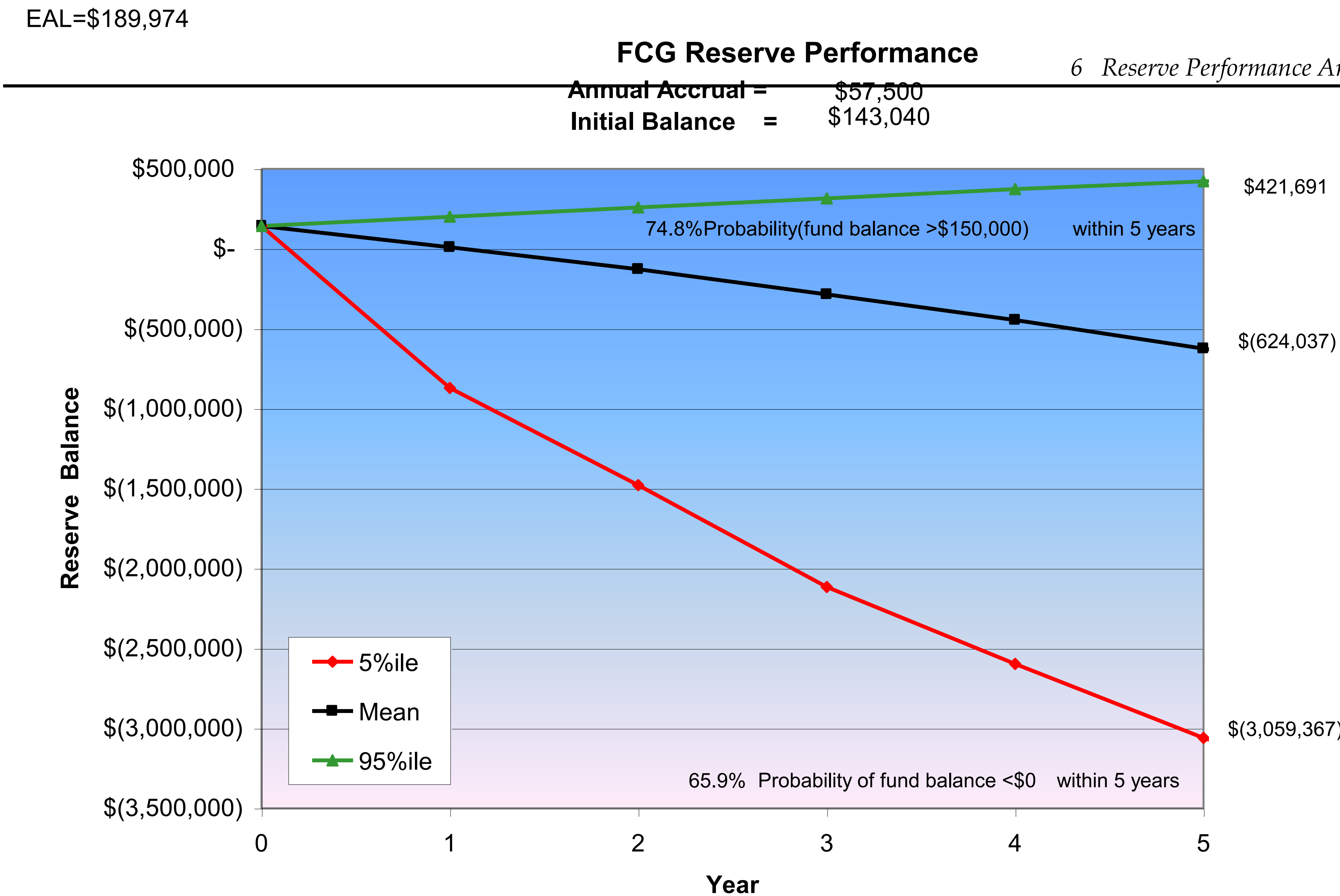


**Figure 6-1: Reserve Performance Analysis: $143,040 Initial Balance, No Recovery of Negative Balances**

EAL=$189,974



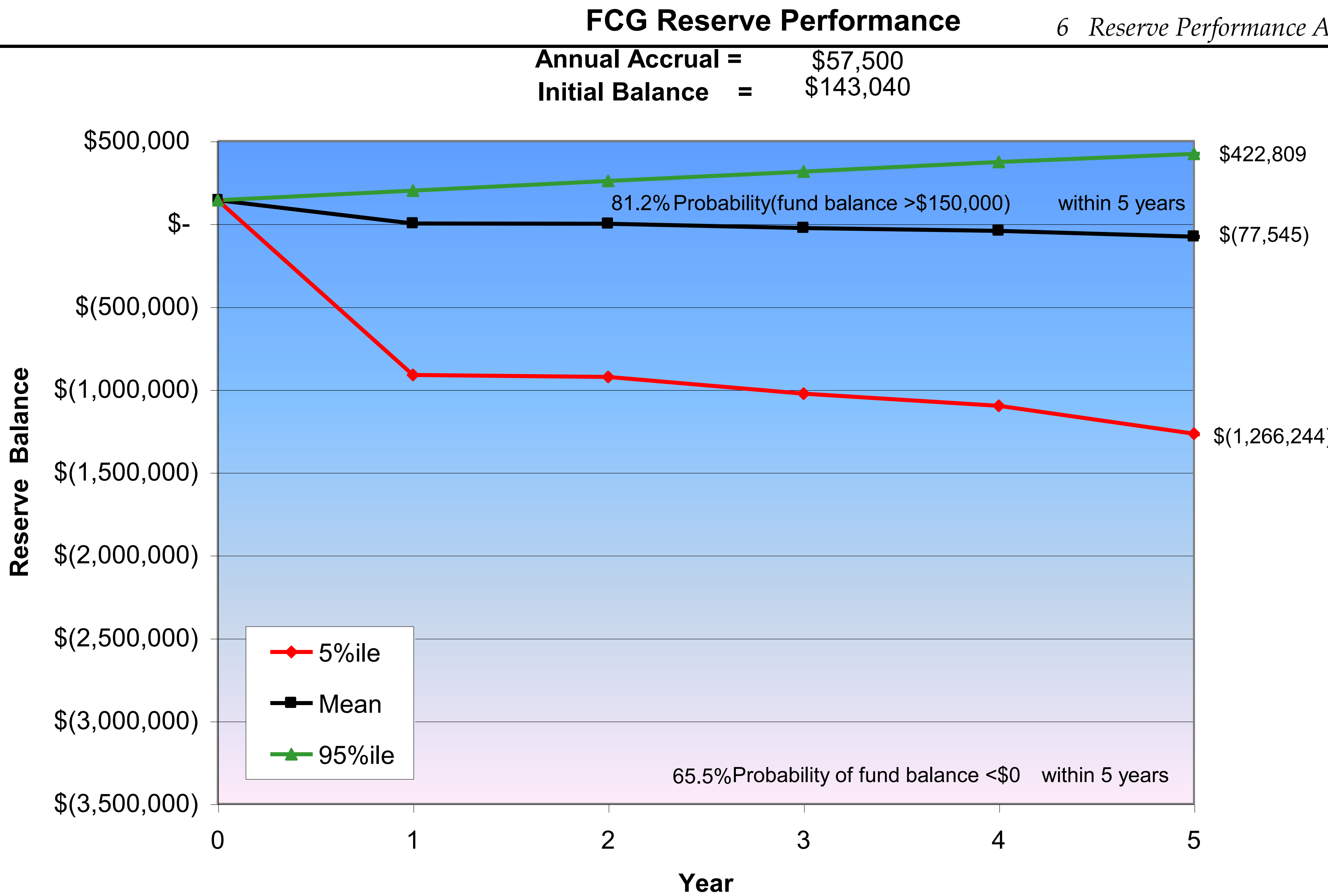


**Figure 6-2: Reserve Performance Analysis: $143,040 Initial Balance, A One (1) Year Recovery of Negative Balances**

# 7. References


1. “Florida Commission on Hurricane Loss Projection Methodology, CoreLogic North Atlantic Hurricane Model in Risk Quantification and Engineering™ November 2020 Submission, April 30, 2021 Version”

**ABSG CONSULTING INC.**
300 Commerce Drive, Suite 150
Irvine, CA 92602
Telephone 714-734-4242
Fax 714-734-4272

**ABS Consulting**

**ABS GROUP OF COMPANIES, INC.**
1701 City Plaza Drive
Spring, TX 77389
Telephone 281-673-2800
Fax 281-673-2801

## NORTH AMERICA

1525 Wilson Boulevard, Suite 625
Arlington, VA 22209
Telephone 703-682-7373
Fax 703-682-7374

1745 Shea Center Drive, Suite 400
Highland Ranch, CO 80129
Telephone 303-674-2990

10301 Technology Drive
Knoxville, TN 37932
Telephone 865-966-5232
Fax 865-966-5287

1360 Truxtun Avenue, Suite 103
North Charleston, SC 29405
Telephone 843-297-0690

18215 Flower Hill Way, Suite D
Gaithersburg, MD 20879
Telephone 301-907-9100
Fax 301-990-7185

140 Heimer Road, Suite 300
San Antonio, TX 78232
Telephone 210-495-5195
Fax 210-495-5134

55 Westport Plaza, Suite 700
St. Louis, MO 63146
Telephone 314-819-1550
Fax 314-819-1551

## MEXICO

Ciudad del Carmen, Mexico
Telephone 52-938-382-4530

Mexico City, Mexico
Telephone 52-55-5511-4240

Monterrey, Mexico
Telephone 52-81-8319-0290

Reynosa, Mexico
Telephone 52-899-920-2642

Veracruz, Mexico
Telephone 52-229-980-8133

## UNITED KINGDOM

111 Old Broad Street
London, EC2N 1AP, UK
Telephone 44-1925-287300

## SOUTH AMERICA

Rio de Janeiro, Brazil
Telephone 55-21-3179-3182

Sao Paulo, Brazil
Telephone 55-11-3707-1055

Viña del Mar, Chile
Telephone 56-32-2381780

Lima, Peru
Telephone 51-1-437-7430

Chuao, Venezuela
Telephone 58-212-959-7442

## MIDDLE EAST

Dhahran, Kingdom of Saudi Arabia
Telephone 966-3-868-9999

Ahmadi, Kuwait
Telephone 965-3263886

Doha, State of Qatar
Telephone 974-44-13106

Muscat, Sultanate of Oman
Telephone 968-597950

Istanbul, Turkey
Telephone 90-212-6614127

Abu Dhabi, United Arab Emirates
Telephone 971-2-6912000

Dubai, United Arab Emirates
Telephone 971-4-3306116

## EUROPE

Sofia, Bulgaria
Telephone 359-2-9632049

Hamburg, Germany
Telephone 49-40-300-92-22-21

Rotterdam, The Netherlands
Telephone 31-10-206-0778

## ASIA-PACIFIC

Ahmedabad, India
Telephone 079 4000 9595

Navi Mumbai, India
Telephone 91-22-757-8780

New Delhi, India
Telephone 91-11-45634738

Yokohama, Japan
Telephone 81-45-450-1250

Busan, Korea
Telephone 82-51-852-4661

Seoul, Korea
Telephone 82-2-552-4661

Kuala Lumpur, Malaysia
Telephone 608-6212320888

Beijing, PR China
Telephone 86-10-58112921

Shanghai, PR China
Telephone 86-21-6876-9266

Kaohsiung, Taiwan, Republic of China
Telephone 886-7-271-3463

Alexandra Point, Singapore
Telephone 65-6270-8663

Bangkok, Thailand
Telephone 662-399-2420

## INTERNET

Additional office information can be found at *www.abs-group.com*