City of Galveston

DEPARTMENT OF ENGINEERING

Robert L. Winiecke, P.E., CFM, Director of Infrastructure & Engineering
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Date: February 27, 2025

To: Brian Maxwell, City Manager
Honorable Mayor and City Council Members

From: Robert L. Winiecke, P.E., CFM, Director of Infrastructure & Engineering

Project Location: Karankawa Beach & Gulf Palms Subdivisions

Project: Karankawa Beach & Gulf Palms Drainage Improvements (CIP #D2501)

Request: Consider for approval a professional services contract with Pape-Dawson Engineers (Pape-Dawson) to conduct the engineering design of the Karankawa Beach & Gulf Palms Drainage Improvement project for the City of Galveston in the amount of $969,555.00; Authorizing the City Manager to execute all necessary documents upon final approval by the City Attorney.

Prior Council Action:

A. There has been no prior City Council action taken on this item.

Current Situation:

A. The city undertook the development of a new Stormwater Master Plan in 2022 and is working with the Consultant to finalize this report.
B. The Stormwater Master Plan identifies eighteen (18) problem zones on Galveston Island that exhibit similar drainage characteristics, sewer connectivity, and overland flow drainage area boundaries. These problem zones were developed to understand the physical infrastructure and then identify deficiencies that are potential causes of the flooding issues in the given problem zone.
C. Problem Zone 6 – Indian Beach was identified in the Stormwater Master Plan which includes the Karankawa Beach & Gulf Palms Subdivisions as an area of concern.
D. Prior to the Stormwater Master Plan undertaking, through Work Order tracking and prior discussions with residents, Staff was already aware of flooding complaints and drainage issues in these subdivisions.
E. These two subdivisions are located south of FM3005 and previously drained towards the Gulf facing beaches.
F. The streets in the Karankawa Beach Subdivision (Habla and Glei) hold water during rainfall events, high tide events, and tropical events.
G. In the past, the City's Draining Division regularly dispatched a crew and mobile trash pump to the Karankawa Beach Subdivision to pump water from the roads to reduce the duration of water ponding on the roadways.

H. The outfall of these subdivisions is located at the northwest corner of the Karankawa Beach Subdivision adjacent to FM3005, and the land in the subdivision is lower than the roadside ditches along FM3005, therefore runoff is unable to evacuate from the neighborhood.
I. These subdivisions are also served by privately owned and maintained sanitary waste disposal systems (e.g., septic tanks).
J. The lack of positive drainage in these subdivisions has the potential to reduce the functionality of these waste disposal systems that rely on bacteriological processes and the environment for filtering.

Fiscal Impact Report:
This project is identified in the FY2025-FY2029 Capital Improvement Plan (CIP) as Project No. D2501, and the following table shows the funding allocation for this project:

Funding Source		Amount
IDC		$969,555.00
	Total:	$969,555.00

Alternatives:
1. Approve this request and authorize Staff to begin the engineering design phase of the Karankawa Beach & Gulf Palms Drainage Improvement project for the city.
2. Instruct Staff to seek out another firm to prepare the engineering design for the city and delay this project.

Staff Recommendation:

Staff recommends approving the professional services contract with Pape-Dawson to prepare the engineering design for the Karankawa Beach & Gulf Palms Drainage Improvements for the City of Galveston.

Respectfully Submitted,

Robert Winiecke, P.E., CFM
Director of Infrastructure and Engineering

Attachments:
Contract # COG-CON-25-___
Problem Zone 6 – Indian Beach description from the DRAFT Stormwater Master Plan Report
Karankawa Beach & Gulf Palms Drainage Improvements, Project Summary from DRAFT SWMP Report
Karankawa Beach & Gulf Palms Drainage Improvements, Project Exhibits from DRAFT SWMP Report
Pre-Qualified Engineer's List

The area of Problem Zone 4 south of FM 3005 should drain north towards the road and eventually outfall to the West Bay. However, there are raised areas along the southern corridor of FM 3005 that prevent sheet flow from reaching the roadside ditches and cross culverts, so instead flow is redirected south towards the Gulf of Mexico via overland swales and beach access roadways.

In the 5-year storm event, portions of Sandhill Drive, Sunset Bay Drive, and Sea Grass Lane are subject to ponding depth greater than 1.0' and ponding durations greater than 6 hours. The eastern portion of Sandhill Drive experiences ponding depth less than 0.5', and the remaining roads in Problem Zone 4 generally experience ponding less than 0.25'. North of FM 3005, ponding extents are contained to public ROW and low-lying undeveloped areas. South of FM 3005, the ponding extents are not contained to public ROW due to water flowing towards the beach. Several structures have ponding underneath them; however, since the structures are elevated in this area, there is minimal structural risk. These trends continue in the 10-, 25-, and 100-year storm events, with minimal changes in ponding extents but increases in ponding depth and duration for the larger storm events. There are approximately 3 FEMA repetitive loss structures located within Problem Zone 4.

10.5 Problem Zone 5 – Maggie's Cove

Problem Zone 5 is roughly bound by the West Bay on the north, Gulf of Mexico on the south, Kiva Road on the east, and Sunset Bay Drive on the west. Problem Zone 5 is served primarily by roadside ditches along FM 3005 that drain into the bay.

Problem Zone 5 has a topographic high point along FM 3005 that separates the low-lying residential areas to the south, and open space to the north that drains directly to the bay via sheetflow and ditches. The subdivisions south of FM 3005 are restricted by the elevated ridge of FM 3005. While there are culvert crossings that allow the subdivisions to drain north (underneath FM 3005), the existing ditch slopes and grading do not effectively get water to, and through, these culverts.

The subdivisions south of FM 3005 exhibit progressively severe parcel and roadway ponding as storm event return periods increase due to sheetflow being limited by the poor grading of open ditches and the inability for water to drain north. Kahala Beach experiences long duration ponding in the road throughout each storm event and widespread structure flooding. The Dunes of West Beach subdivision also experience long duration road ponding as storm intensity increases. There is minimal development, with public drainage infrastructure, north of FM 3005 for flooding to impact in Problem Zone 5 other than the Seaside Resort private development.

Problem Zone 5 has zero FEMA repetitive loss structures, so structural damages due to flooding does not appear to be a major concern in this area.

10.6 Problem Zone 6 – Indian Beach

Problem Zone 6 is roughly bound by the West Bay on the north, Gulf of Mexico on the south, Jamaica Beach on the east, and Kiva Road on the west. Problem Zone 6 is served primarily by roadside ditches and cross culverts. This area includes the Indian Beach and Karankawa Beach subdivisions. The Karankawa Beach subdivision, located between FM 3005 and the beach, drains north towards the FM 3005 cross culverts via minor roadside ditches.

Due to the low topography and poor grading of the internal drainage systems within the Karankawa Beach neighborhood, water is unable to fully drain across FM 3005. While there are culverts intended to drain this area, the 5-year storm event shows ponding well outside of the public ROW along Habla Drive and Bristow Drive. This area is known to have flooding issues that cause significant impacts to the residents' ability to access their properties.

Indian Beach consists of minor roadside ditches connected via driveway culverts that meander towards the West Bay. A portion of the Indian Beach subdivision is located south of FM 3005 and experiences similar deficiencies as Karankawa Beach, with the exception that long duration ponding following intense storm events. West De Vaca Lane and East De Vaca Lane experience significant ponding for all storm events due to the insufficient capacity and poor grading of the systems connected through FM 3005. The portion of Indian Beach north of FM 3005 does not experience significant roadway flooding for the 5-year storm, with most ponding being in low-lying open spaces with no structures.

The 100-year storm event causes significant flooding impacts to the subdivisions south of FM 3005, with widespread roadway and parcel ponding that exceeds 1.0'. Additionally, the 100-year storm event begins to cause roadway flooding in the northern section of Indian Beach along Warrior Court and Kiva Road. Shallow ponding outside of the public ROW is present across most of Problem Zone 6, with occasional damage possible to structures that are not significantly elevated. There are approximately 12 FEMA repetitive loss structures located within Problem Zone 6.

10.7 Problem Zone 7 – Galveston Country Club (Lake Como)

Problem Zone 7 is roughly bound by the West Bay on the north, FM 3005 on the south, Pabst Road on the east, and Jamaica Beach on the west. Problem Zone 7 is served primarily by roadside ditches and natural, meandering channels that drain directly north towards the West Bay through a series of wetlands, coves, lakes, and bayous. Residential subdivisions around the Galveston Country Club drain directly off elevated roadway centerlines to roadside ditch systems that carry flow to their respective outfalls into the West Bay. In some instances, runoff drains directly off roadways, through residential properties, and directly into Lake Como, Delehide Cove, or Eckert Bayou. Some of the primary subdivisions located in Problem Zone 7 are Pirate's Cove, Lafitte's Cove, and Palm Beach. The Galveston Island State Park is located along the western side of Problem Zone 7 and is made up of mainly undeveloped land with several narrow, developed ditches to convey water away from FM 3005.

Approximately 12 separate culvert crossings convey offsite flow from south of FM 3005 (Problem Zone 8) to Problem Zone 7. This flow is discharged either directly into the undeveloped land of Galveston Island State Park or into the ditches located along the northern ROW of FM 3005.

The 5-year storm event does not significantly impact Problem Zone 7 with flooding issues beyond localized roadway ponding along Eckert Drive, and Stewart Road between El Lago Street and Pirates Beach Circle.

The 100-year storm event causes widespread flooding issues along, and around, Stewart Road between 12 Mile Road and 13 Mile Road. Depths exceed 1.0' along Stewart Road and shallow ponding extends outside of the public ROW onto residential properties; however, the risk of structural flooding in Problem Zone 7 is generally low relative to other parts of the City. There are approximately four FEMA repetitive loss structures located within Problem Zone 7. Roadway ponding depth along El Lago Street, Las Palmas Street, Marina Boulevard, and Pirates Beach Circle exceed 2.0' along the full span of those streets from Stewart Road near FM 3005, resulting in significant mobility impacts to the area.

10.8 Problem Zone 8 – Pirates Beach

Problem Zone 8 is roughly bound by the West Bay on the northeast and FM 3005 on the northwest, Gulf of Mexico on the south, Millie's Road on the east, and Jamaica Beach on the west. South of FM 3005, Problem Zone 8 includes Galveston State Park and the Pirate's Beach, Bermuda Beach, and Spanish Grant subdivisions which are all served fully by roadside ditches and minor cross culverts that drain directly to FM 3005. North of

15.3.4 Karankawa Beach and Gulf Palms Subdivisions

15.3.4.1 Area of Influence

For the Karankawa Beach and Gulf Palms subdivisions, the area of influence covers Problem Zone 6 and is roughly bound by Termini San Luis Pass Road on the north, the Gulf of Mexico on the south, 16 Mile Road on the east, and Antigua Drive on the west. The modeled area of influence for the Karankawa Beach & Gulf Palms Subdivision improvement is shown on **Exhibit 448**.

15.3.4.2 Baseline Conditions

Existing Drainage Infrastructure

The existing Karankawa Beach & Gulf Palms subdivisions' drainage system consists of small diameter driveway culverts directing water north into the roadside ditch along FM 3005 to ultimately drain into the Bay.

System Deficiencies

The Karankawa Beach and Gulf Palms drainage system only consists of driveway culverts draining into FM 3005's roadside ditch causing extended duration roadway flooding and occasional structural flooding. The Karankawa Beach and Gulf Palms drainage system improvements are intended to target the identified damage center for the Karankawa Beach & Gulf Palms area.

Within Karankawa Beach and Gulf Palms, areas along Glei Street and Bristow Drive have poorly graded, maintained, and missing ditches and culverts. The sedimentation and clogging exacerbate ponding along Glei Street, Habla Street, Bristow Drive, and 16 Mile Rd. FM 3005's roadside ditch and elevation limits drainage to the north causing extensive flooding duration.

Performance Metrics

Table 44 contains the performance metrics for each storm event for Karankawa Beach & Gulf Palms Subdivision.

Table 44. Baseline Performance Metrics – Karankawa Beach & Gulf Palms Subdivision

Recurrence Interval	Parcels	Roadway Ponding (miles)		Number of Intersections		Number of Structures
	< 1 acre & > 50% Ponded	*Depth (above 6")*	*Duration (> 3hrs)*	*Depth (above 6")*	*Duration (> 3hrs)*	*Depth (above 6")*
5-Year	35	0	0	2	2	12
10-Year	44	0	0	2	2	15
25-Year	51	0	0	4	2	17
100-Year	65	0	0	5	4	25
Total in AOI	143	1		5		99

15.3.4.3 Project Description

The Karankawa Beach and Gulf Palms drainage improvements involve the deepening and re-grading of existing roadside ditches within both subdivisions and along FM 3005, an improved outfall channel west of Kiva Road, new storm sewer along FM 3005, Antigua Drive, Habla Drive, Bristow Drive, and 16 Mile Road, and a pump associated with the FM 3005 cross culvert between Antigua Drive and Habla Drive. The pump will allow water in the two subdivisions to drain north across FM 3005 and west towards the outfall channel. The project also involves the replacement of water and sewer lines impacted by the improved ditches and new storm sewer. As shown on **Exhibit 448**, the Karankawa Beach & Gulf Palms drainage improvements include approximately:

- 13,700 linear feet of roadside ditch re-grading
- 2,100 linear feet of open channel widening.
- 7,600 linear feet of storm sewer ranging from 3'x2' RCB to 9'x5' RCB
- 31 culvert crossings

An alternative configuration for this improvement was considered which would shorten the overall distance from the Karankawa Beach subdivision. However, ROW acquisition would be required as the alternative alignment would need to extend directly north from FM 3005 to a new outfall into the Bay. The proposed alignment stays mostly within publicly-owned ROW and does not require substantial ROW acquisition.

15.3.4.4 Phasing Considerations

The Karankawa Beach and Gulf Palms drainage improvements do not require phasing with other proposed improvements. However, if the limits of the improvements developed in this master plan are subdivided into smaller project phases, it is recommended to start at the storm sewer or ditch outfalls and work upstream.

15.3.4.5 Proposed Performance Metrics

Table 45 contains the proposed depth and duration reductions for the performance metrics of all storm events for Karankawa Beach and Gulf Palms Subdivision. **Exhibits 449-471** show the corresponding layout of these benefits for all evaluated storm events and associated performance metrics. The percent reductions represent the share of the respective infrastructure and metric that is brought below the measured threshold from baseline to proposed conditions within the project area of influence. For example, 56% of roadway miles that experienced a flood depth above 6 inches within the AOI under 10-year baseline conditions have been reduced to a depth below 6 inches under the 10-year proposed conditions. The proposed performance metrics are intended to quantify project benefits and allow for the prioritization and scoring of all capital projects outlined in this plan.

Table 45. Proposed Performance Metrics Reductions – Karankawa Beach and Gulf Palms Subdivision

Recurrence Interval	Scoring Weight					
	15%	20%	5%	*25%*	*10%*	*25%*
	Parcels	**Roadway Ponding (miles)**		**Number of Intersections**		**Number of Structures**
	< 1 acre & > 50% Ponded	***Depth (above 6")***	***Duration (> 3hrs)***	***Depth (above 6")***	***Duration (> 3hrs)***	***Depth (above 6")***
5-Year	54%	46%	46%	0%	0%	67%
10-Year	55%	56%	53%	0%	0%	67%
25-Year	37%	41%	56%	0%	0%	59%
100-Year	35%	36%	44%	0%	25%	56%

15.3.4.6 Cost Estimate

An opinion of probable construction cost (OPCC) was developed for the Karankawa Beach and Gulf Palms Subdivision Improvement Project. The individual items included in the cost estimates can be found in **Appendix J**. A summary of the OPCC estimates are shown below in **Table 46.**

Table 46. Cost Estimate – Karankawa Beach & Gulf Palms Subdivision

Easements & ROW	Engineering & Design	Construction	Construction Contingency	Constr. Mgmt & Testing	Grant Administration	Total Cost (2024):
$143,000	$850,000	$4,250,000	$1,276,000	$567,000	$0	**$7,086,000**

15.3.4.7 Benefit-Cost Analysis

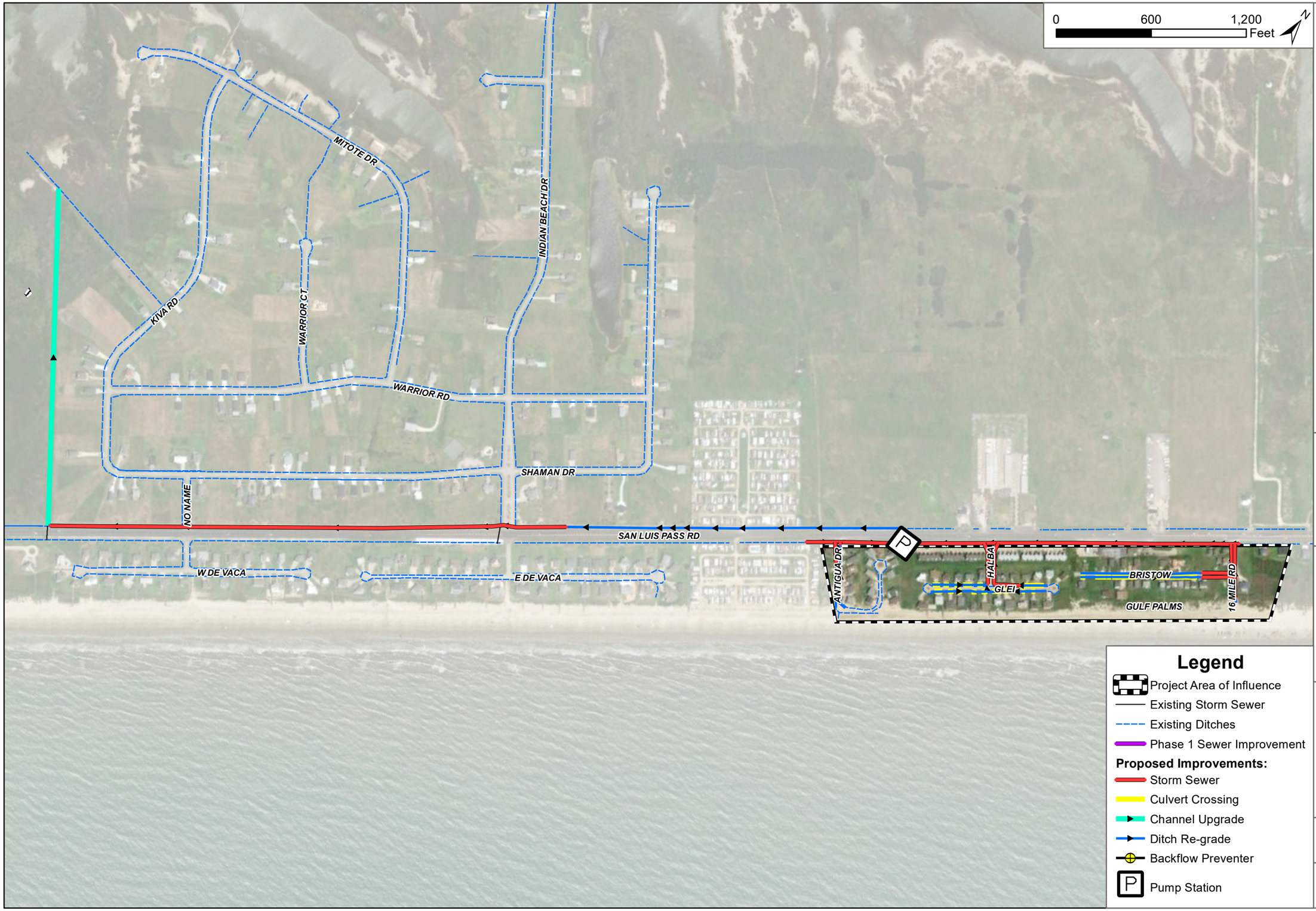
A benefit cost analysis (BCA) was performed to quantify the economic impacts from structural flood damages for the 5-year, 10-year, 25-year, and 100-year design storm event within the project's area of influence. Existing and proposed damages were calculated and annualized to determine the economic benefit provided by the proposed improvements for each design storm event. Annualization of damages refers to applying different weights to each design storm's calculated damages based on the probability of a given storm's chance of occurring in any given year. The annualized damage reduction value (benefit) and annualized cost value are utilized to generate the project's benefit-cost ratio (BCR).

Social benefits were calculated based on the magnitude of residents that live and work within the project's area of influence. As outlined by FEMA, social benefits refer to the dollar value attributed to the mental stress and anxiety of all impacted residents and the lost wages and productivity of all impacted workers that are benefitted by the proposed improvement. **Table 47** shows the social and structural benefits, project cost, and resulting BCR.

Table 47. Benefit-Cost Analysis – Karankawa Beach & Gulf Palms Subdivision

Social Benefits	Structural Benefits	Project Cost	BCR
$15,467	$1,507,258	$7,086,000	0.21

The detailed BCA process is shown in **Appendix K** and calculates a BCR of 0.21 for the Karankawa Beach & Gulf Palms Subdivision drainage improvement project. A BCR lower than 0.5 indicates that the project is not cost-effective, and it should be expected that the City will be responsible for the full cost without partners unless funding opportunities are identified without minimum BCR requirements.



Legend

- Project Area of Influence
- Existing Storm Sewer
- Existing Ditches
- Phase 1 Sewer Improvement

Proposed Improvements:

- Storm Sewer
- Culvert Crossing
- Channel Upgrade
- Ditch Re-grade
- Backflow Preventer
- Pump Station

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
SCHEMATIC LAYOUT

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 448

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

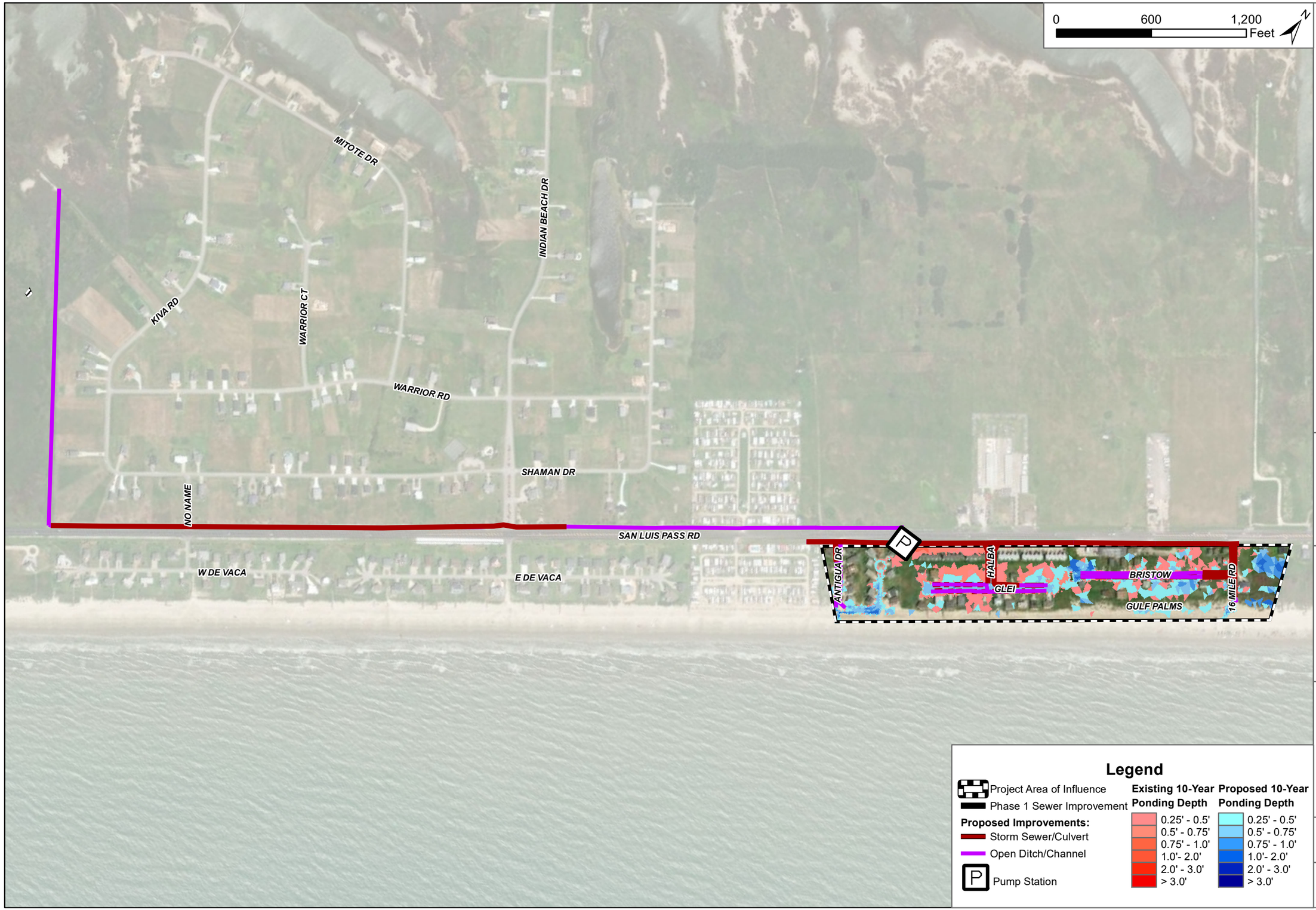
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
5-YEAR PONDING REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 449



CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
10-YEAR PONDING REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 450

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
25-YEAR PONDING REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 451

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
100-YEAR PONDING REDUCTION

PREPARED: JKB

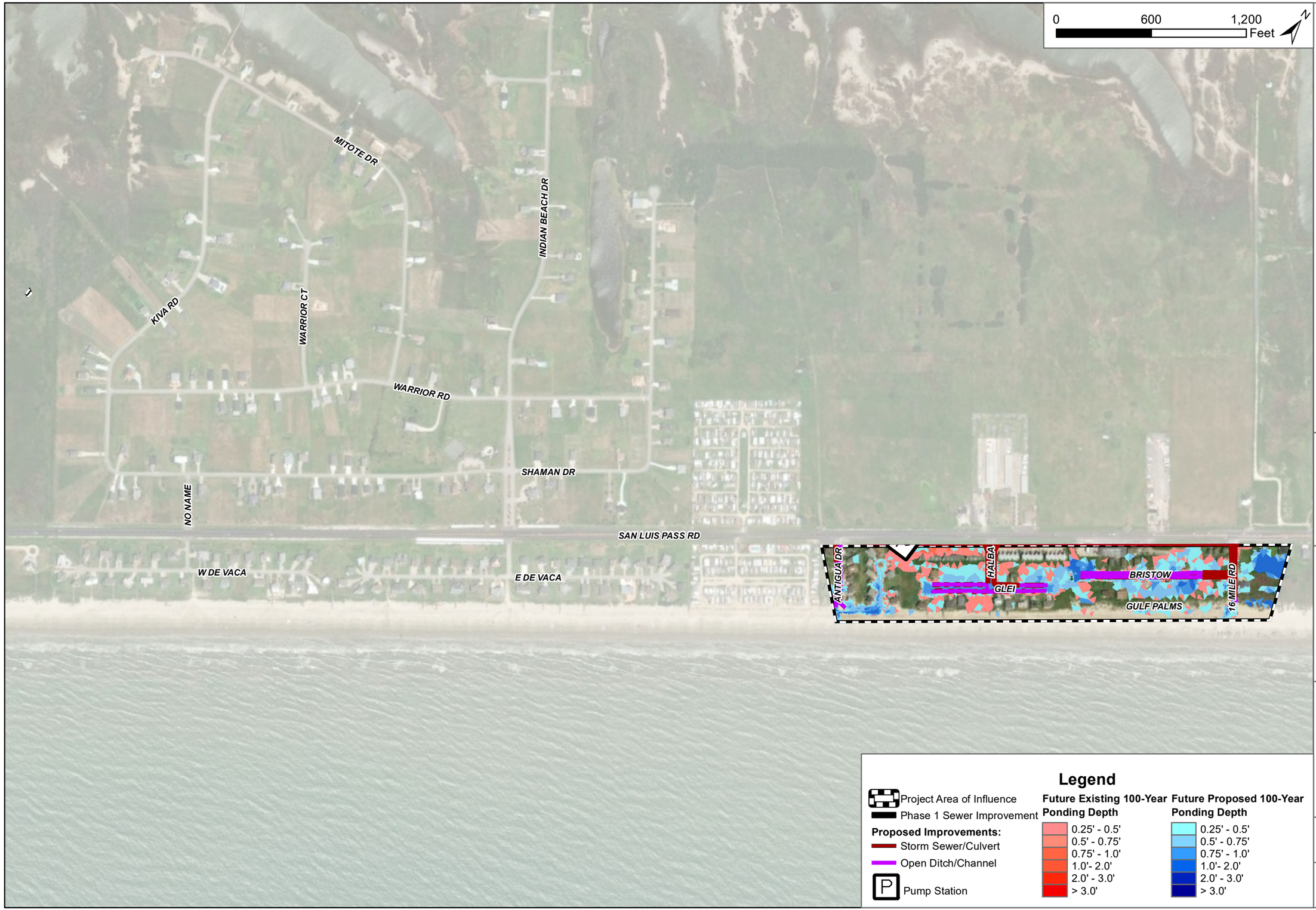
CHECKED: AEP

APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 452



Legend

- Project Area of Influence
- Phase 1 Sewer Improvement

Proposed Improvements:

- Storm Sewer/Culvert
- Open Ditch/Channel
- Pump Station

Future Existing 100-Year Ponding Depth	Future Proposed 100-Year Ponding Depth
0.25' - 0.5'	0.25' - 0.5'
0.5' - 0.75'	0.5' - 0.75'
0.75' - 1.0'	0.75' - 1.0'
1.0'- 2.0'	1.0'- 2.0'
2.0' - 3.0'	2.0' - 3.0'
> 3.0'	> 3.0'

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
FUTURE 100-YEAR PONDING REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 453

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
5-YEAR DEPTH REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 454

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
10-YEAR DEPTH REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 455

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
25-YEAR DEPTH REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 456

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

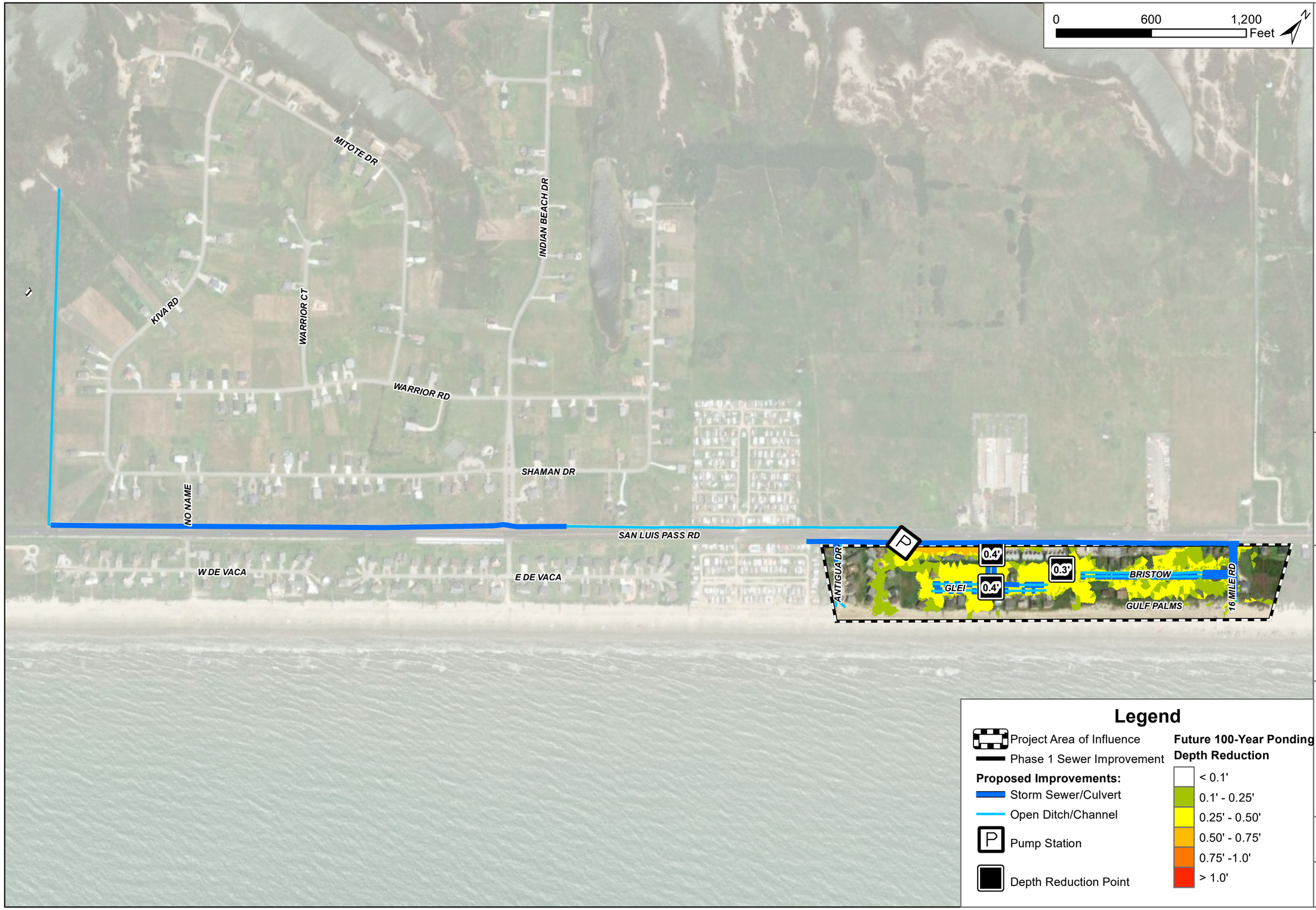
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
100-YEAR DEPTH REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 457



CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

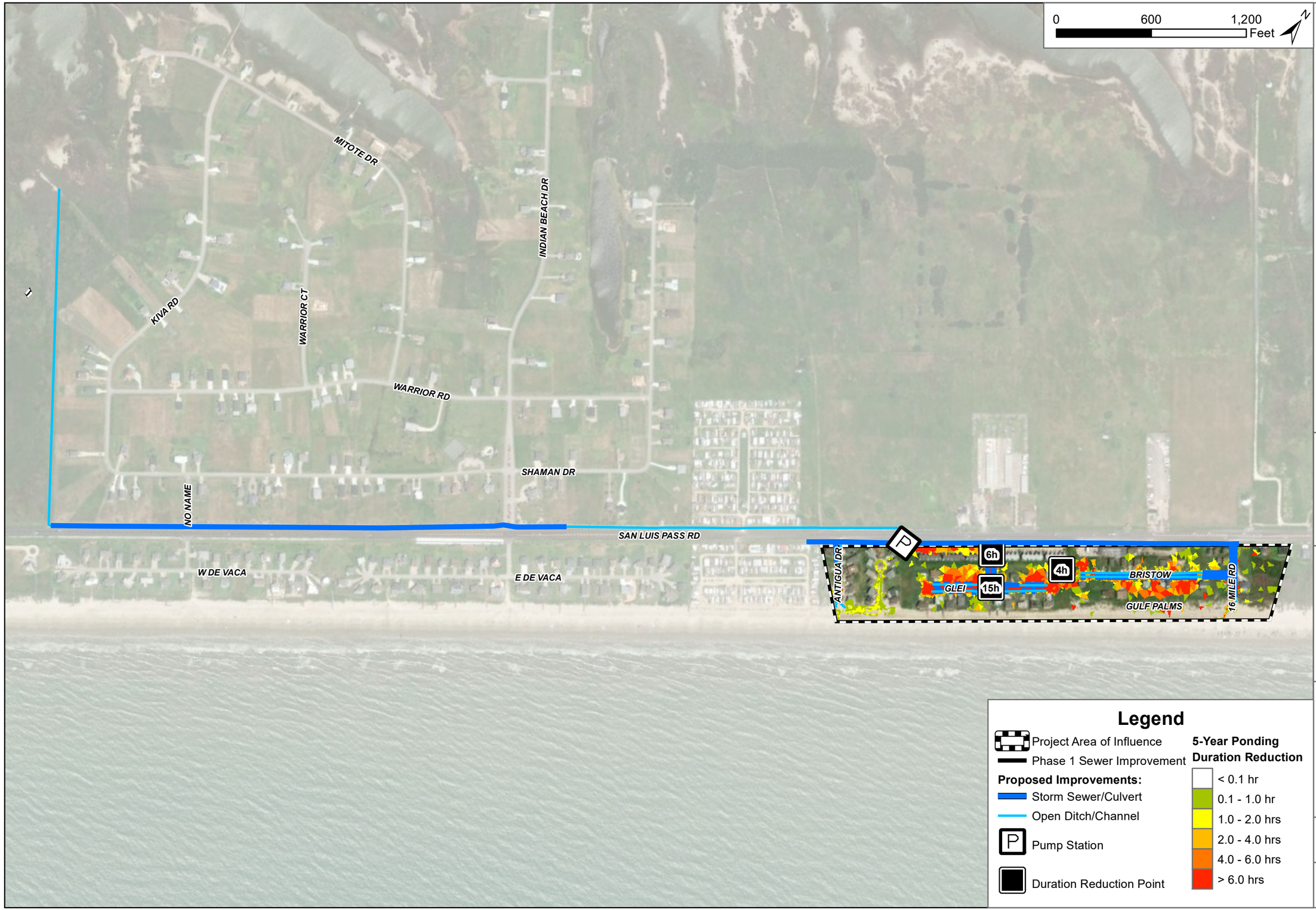
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
FUTURE 100-YEAR DEPTH REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 458



Legend

- Project Area of Influence
- Phase 1 Sewer Improvement

Proposed Improvements:

- Storm Sewer/Culvert
- Open Ditch/Channel
- Pump Station
- Duration Reduction Point

5-Year Ponding Duration Reduction

- < 0.1 hr
- 0.1 - 1.0 hr
- 1.0 - 2.0 hrs
- 2.0 - 4.0 hrs
- 4.0 - 6.0 hrs
- > 6.0 hrs

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

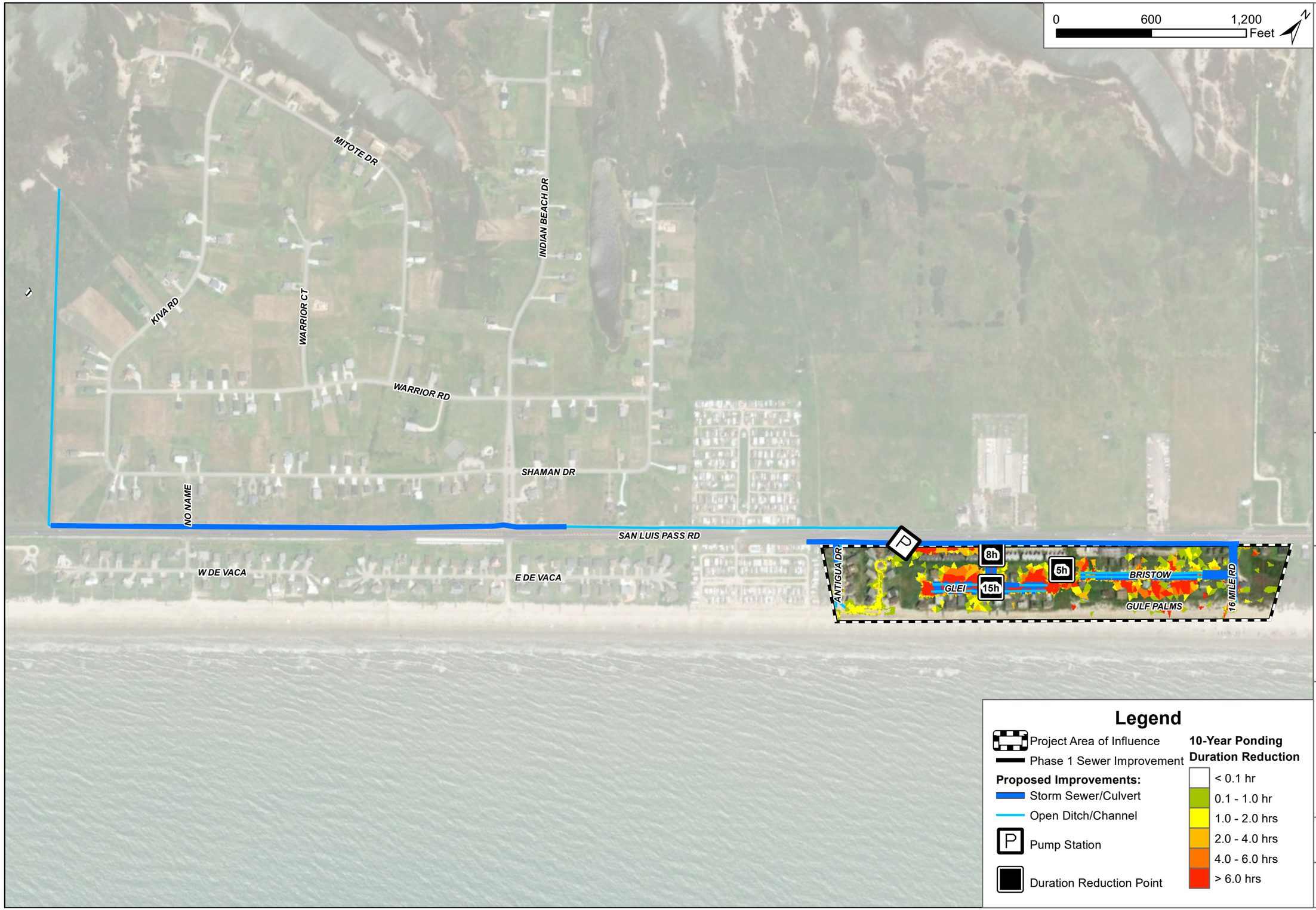
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
5-YEAR DURATION REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 459



CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

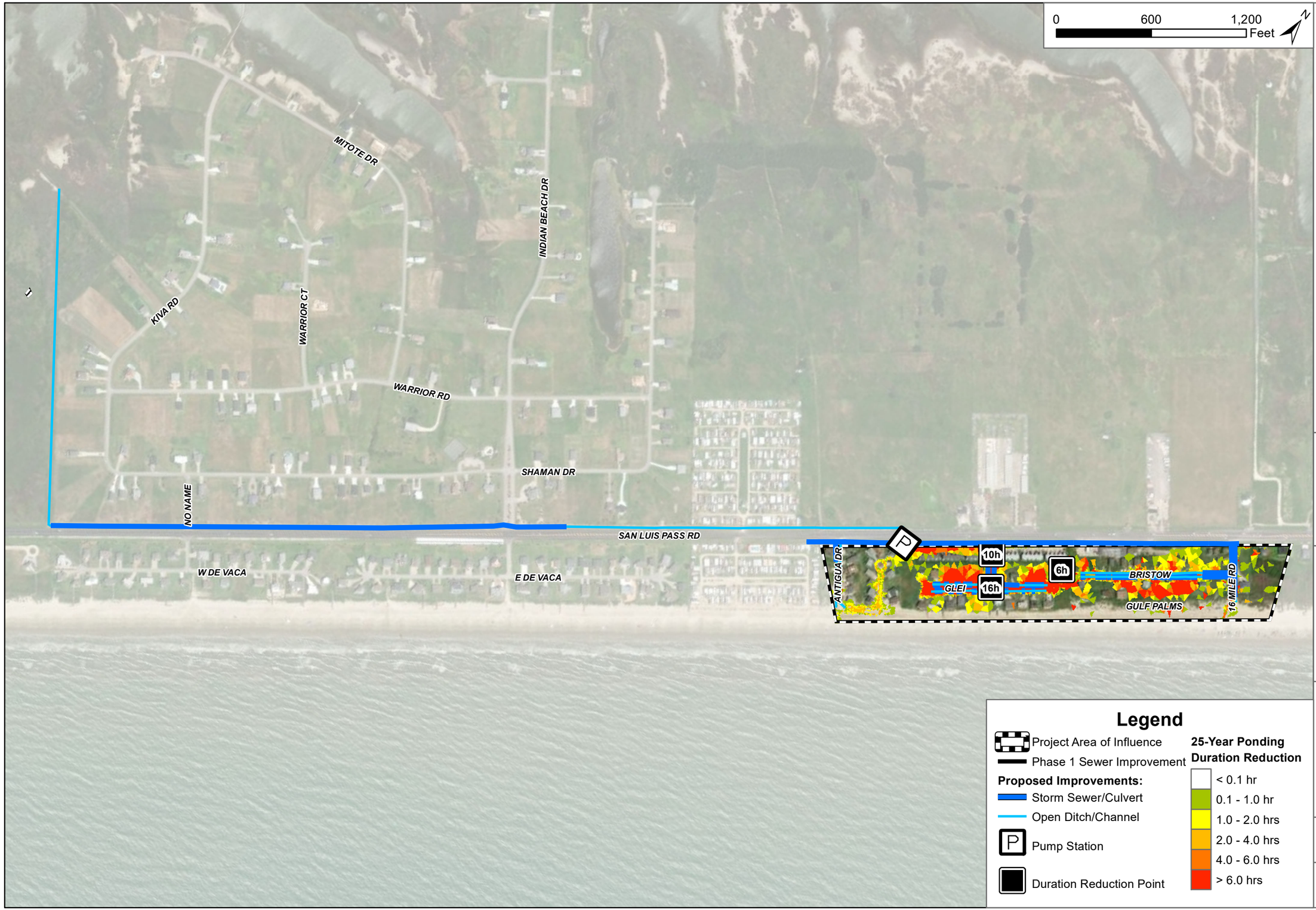
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
10-YEAR DURATION REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 460



CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
25-YEAR DURATION REDUCTION

PREPARED: JKB

CHECKED: AEP

APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

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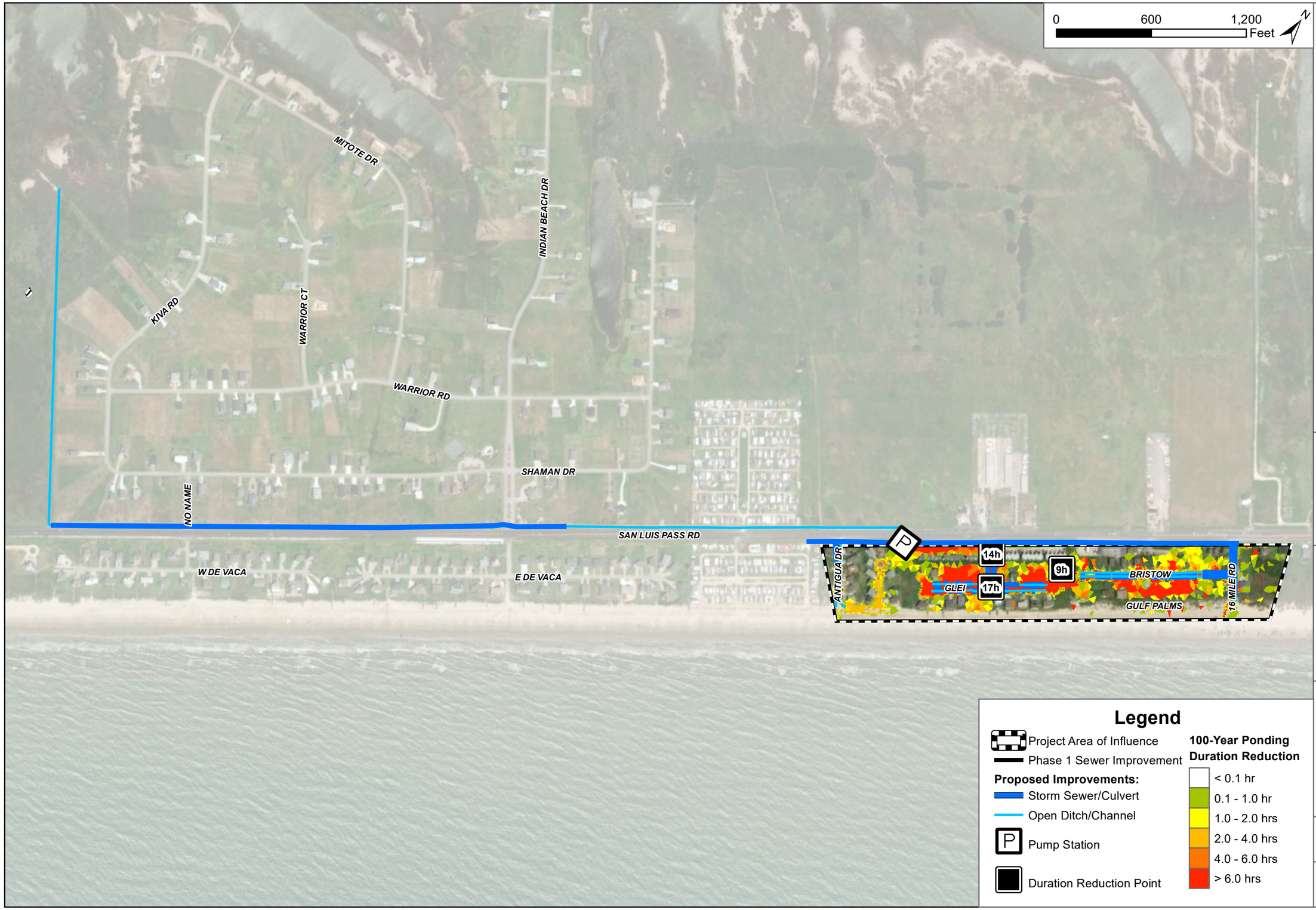
SCALE: AS NOTED

EXHIBIT 461



CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
100-YEAR DURATION REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

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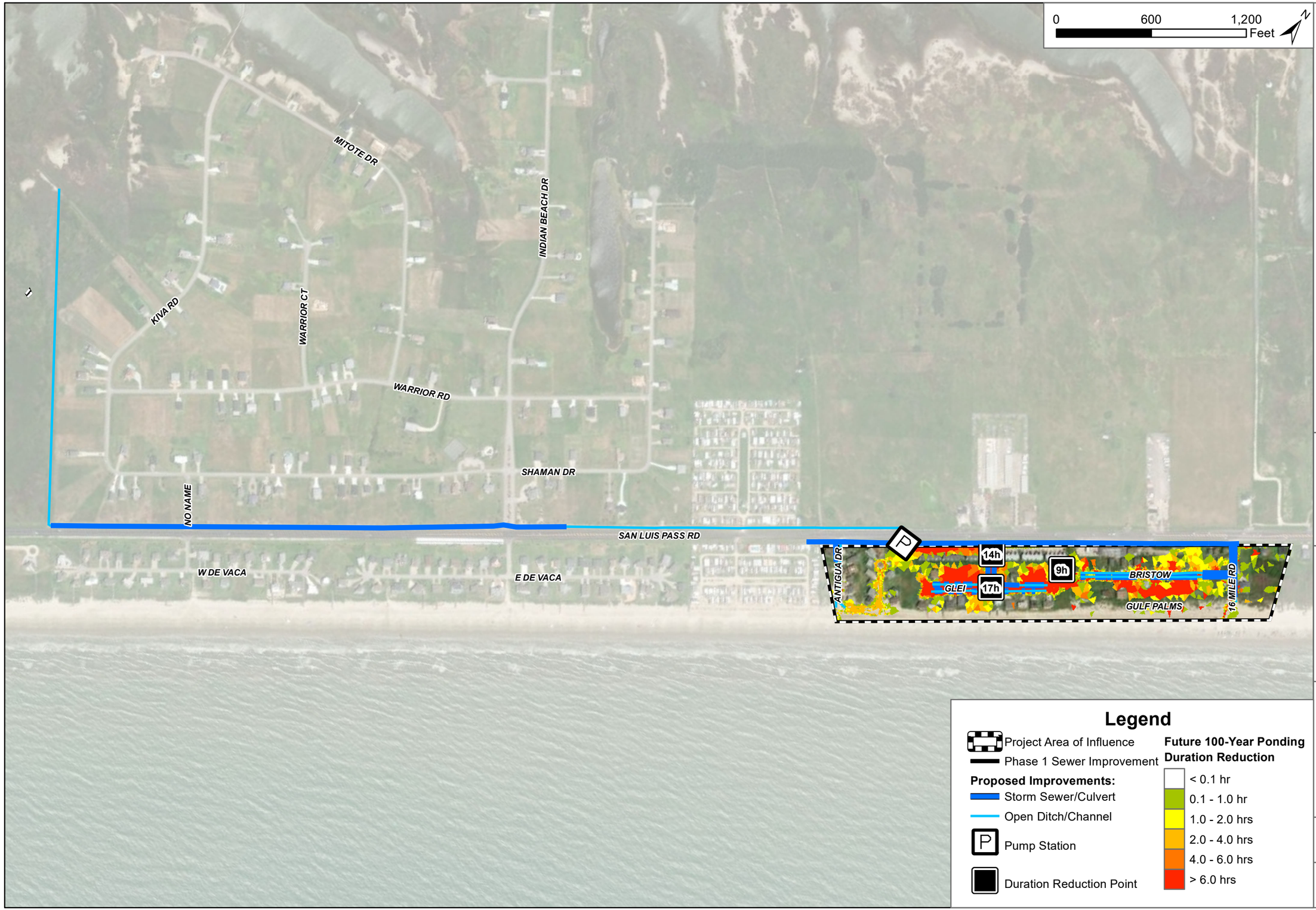
EXHIBIT 462



Legend

- Project Area of Influence
- Phase 1 Sewer Improvement

Proposed Improvements:

- Storm Sewer/Culvert
- Open Ditch/Channel
- Pump Station
- Duration Reduction Point

Future 100-Year Ponding Duration Reduction

- < 0.1 hr
- 0.1 - 1.0 hr
- 1.0 - 2.0 hrs
- 2.0 - 4.0 hrs
- 4.0 - 6.0 hrs
- > 6.0 hrs

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
FUTURE 100-YEAR DURATION REDUCTION

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 463

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
DRAINAGE IMPROVEMENT PROJECT
5-YEAR ROADWAY BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 464

Legend

- Project Area of Influence

Ponded Intersections (> 0.5')

- Existing
- Removed

Ponded Roadway (> 0.5')

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
10-YEAR ROADWAY BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 465

Legend

- Project Area of Influence

Ponded Intersections (> 0.5')

- Existing
- Removed

Ponded Roadway (> 0.5')

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

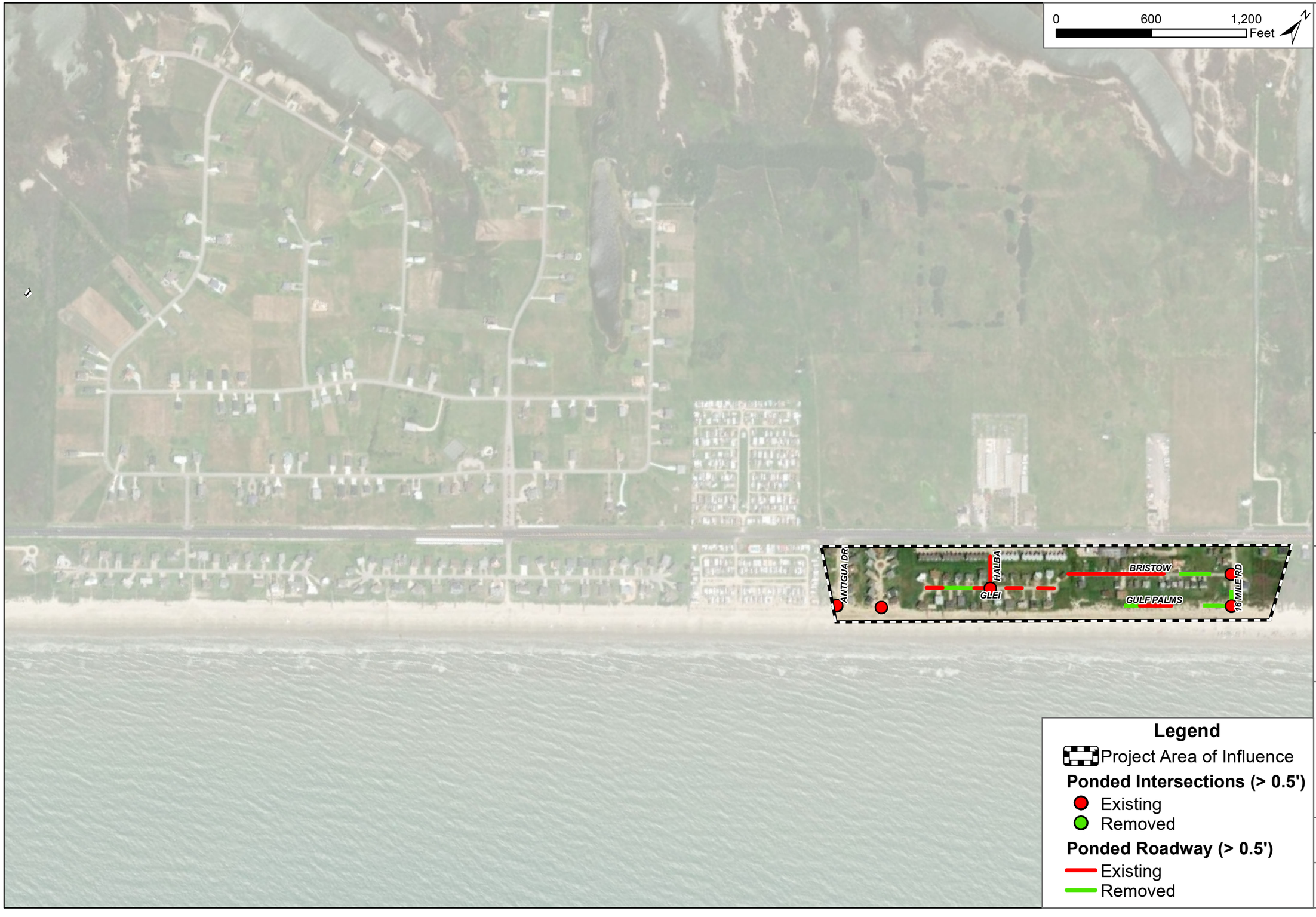
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
25-YEAR ROADWAY BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 466



Legend

- Project Area of Influence

Ponded Intersections (> 0.5')

- Existing
- Removed

Ponded Roadway (> 0.5')

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
100-YEAR ROADWAY BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 467

Legend

Project Area of Influence

Structure Flood Depth (> 0.5')

- Existing
- Removed

Flooded Parcel Area (> 50%)

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
DRAINAGE IMPROVEMENT PROJECT
5-YEAR STRUCTURE & PARCEL BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 468

Legend

Project Area of Influence

Structure Flood Depth (> 0.5')

- Existing
- Removed

Flooded Parcel Area (> 50%)

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

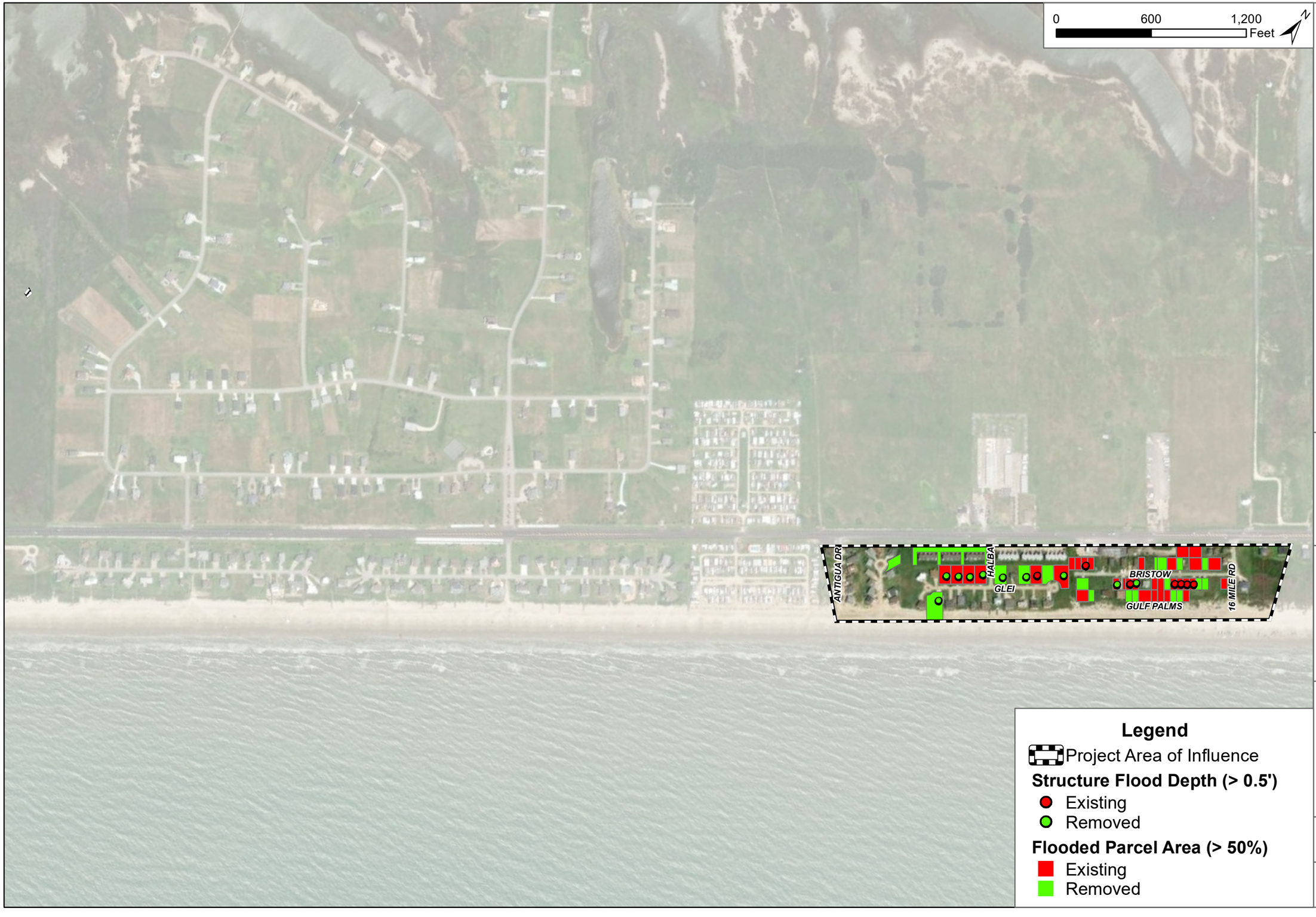
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
10-YEAR STRUCTURE & PARCEL BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 469



Legend

Project Area of Influence

Structure Flood Depth (> 0.5')

- Existing
- Removed

Flooded Parcel Area (> 50%)

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

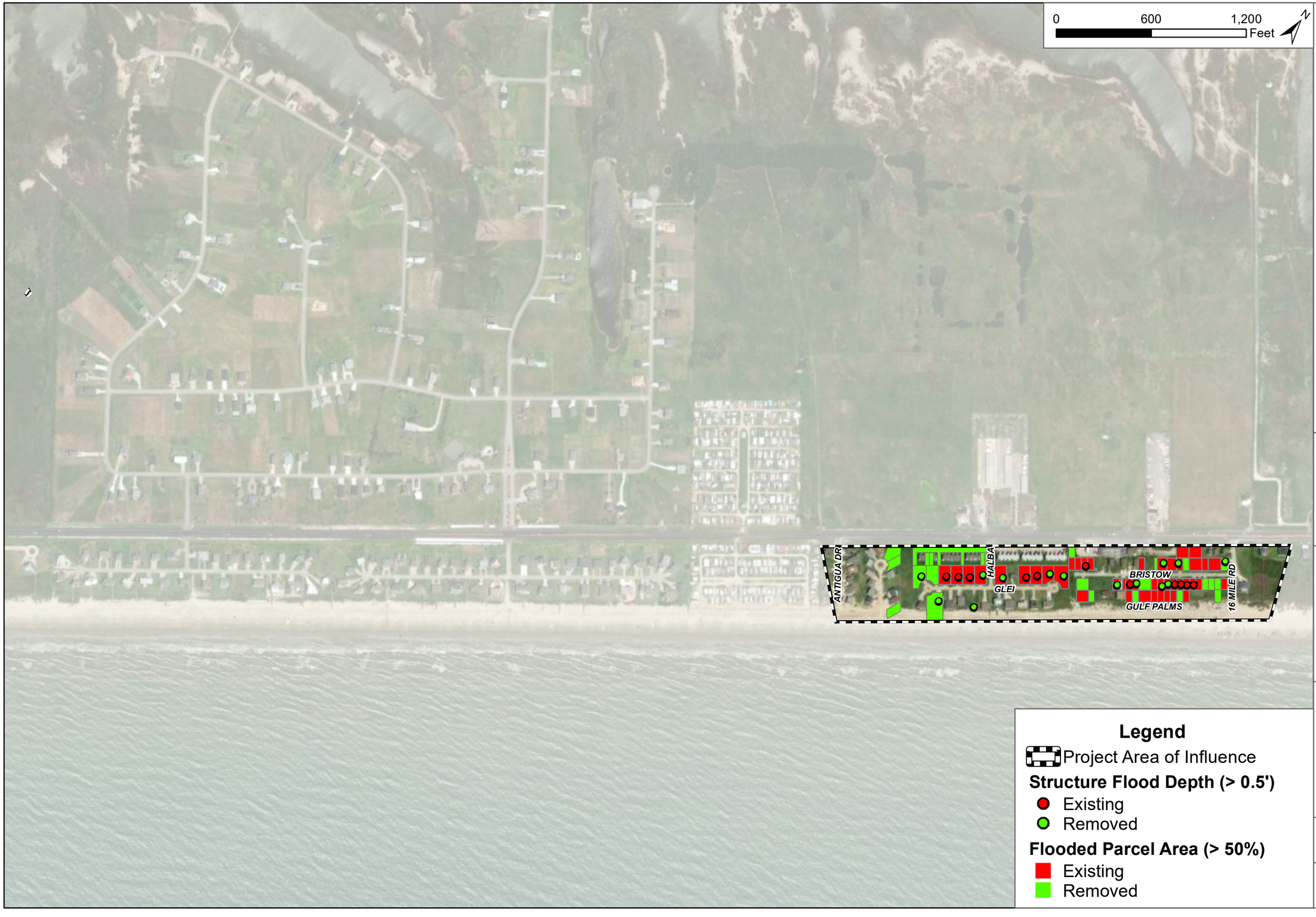
KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
25-YEAR STRUCTURE & PARCEL BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 470



Legend

Project Area of Influence

Structure Flood Depth (> 0.5')

- Existing
- Removed

Flooded Parcel Area (> 50%)

- Existing
- Removed

CITY OF GALVESTON
STORMWATER MASTER PLAN (SWMP)

KARANKAWA BEACH & GULF PALMS
PROPOSED DRAINAGE IMPROVEMENT PROJECT
100-YEAR STRUCTURE & PARCEL BENEFIT METRICS

PREPARED: JKB
CHECKED: AEP
APPROVED: MJM

823 Rosenburg Street
Galveston, Texas 77550

DATE: JAN 2024
SCALE: AS NOTED

EXHIBIT 471

City of Galveston

DEPARTMENT OF ENGINEERING

Robert L. Winiecke, P.E., CFM, Director of Infrastructure & Engineering
rwiniecke@galvestontx.gov | Office Number: (409) 797-3664 | www.galvestontx.gov

PRE-QUALIFIED ENGINEERING FIRMS*

NO. [1.]	FIRM NAME	STREET[1]/ TRAFFIC[2]	DRAINAGE	WATER - DISTRIBUTION	WATER - PLANT, STORAGE, PUMPING	SEWER - COLLECTIONS	WASTEWATER - TREATMENT	GEOTECH[1]/ STRUCTURAL[2]/ FACILITY[3]/ ELECTRICAL[4]	CONST. ENGINEERING MGMT
1	Alliance Geotechnical Group, Inc.							X	
2	Ally General Services, LLC	X[12]	X						X
3	Alpha Testing, LLC							X	
4	Arceneaux Wilson & Cole, LLC	X[12]	X	X	X	X	X		X
5	Ardurra Group	X[12]	X	X	X	X	X	X[23]	X
6	Arredondo, Zepeda & Brunz, LLC	X[12]	X	X	X	X	X		X
7	Binkley & Barfield, Inc.	X[1]	X	X		X	X		X
8	Blackline Engineering, LLC	X[1]	X	X		X			X
9	CivilTech Engineering, Inc,.	X[12]	X	X		X		X[2]	X
10	CSRS, LLC	X[12]	X						X
11	Dally + Associates							X[23]	X
12	DE Corp	X[1]	X	X	X	X	X		X
13	Earth Engineering, Inc.							X[1]	
14	EHRA Engineering	X[12]		X	X	X	X	X[2]	X
15	EJES, Inc.	X[12]	X	X		X		X[1]	X
16	Eustis Engineering, LLC							X[1]	
17	Freese and Nichols, Inc.	X[12]	X	X	X	X	X	X[3]	X
18	GC Engineering, Inc.	X[12]	X	X		X		X[2]	X
19	Halff Associates, Inc.	X[12]	X	X	X	X	X	X[234]	X
20	HDR Engineering, Inc.	X[12]	X	X	X	X	X	X[1234]	X
21	HR Green	X[12]	X	X	X	X	X		X
22	HT&J, LLC		X						
23	Huitt-Zollars, Inc.	X[1]	X	X		X		X[3]	X
24	HVJ Associates, Inc.	X[1]		X	X	X	X	X[1]	X
25	IDS Engineering Group	X[1]	X	X	X	X			
26	Infrastructure Associates, Inc.		X				X		
27	Intercoastal Consultants, LLC		X						
28	Kimley-Horn & Associates, Inc.	X[12]	X	X	X	X	X		
29	Lockwood, Andrews and Newman	X[12]	X	X	X	X	X	X[234]	
30	McDonough Engineering Corporation	X[1]	X	X	X	X			X
31	Millennium Engineers Group, inc.							X[1]	
32	Pape-Dawson Engineering, Inc.	X[1]	X			X	X		
33	Professional Service Industries, Inc.							X[1]	
34	Raba Kistner, Inc.							X[1]	
35	Riner Engineering, Inc.							X[1]	
36	RJN Group, Inc.	X[1]		X	X	X			X
37	Stantec Consulting Services, Inc.	X[12]	X	X	X	X	X	X[1234]	X
38	T. Baker Smith, LLC	X[1]	X	X	X	X	X	X[2]	X
39	Terracon Consultants, LLC							X[1]	
40	Tetra Tech, Inc.			X	X	X	X		
41	The Goodman Corporation	X[12]							
42	Walter P Moore	X[12]	X	X	X	X		X[23]	
43	WGI, Inc.	X[12]	X	X		X		X[124]	X
44	Zarinkelk Engineering Services, Inc.	X[12]	X	X		X	X	X[23]	
45	Zero/Six Consulting, LLC							X[3]	