Public Services & Facilities Committee
9:00 a.m., Tuesday, August 20, 2024
1207 Palm Boulevard
City Hall Council Chambers

Public Comment:
All citizens who wish to speak during the meeting must email their first and last name, address and topic to Nicole DeNeane, City Clerk, at nicoled@iop.net no later than **3:00 p.m. the day before the meeting.** Citizens may also provide written public comment here: https://www.iop.net/public-comment-form

Agenda

1. **Call to order** and acknowledgment that the press and the public have been duly notified of the meeting in accordance with the Freedom of Information Act.

2. **Citizens' Comments –** All comments have a time limit of three (3) minutes.

3. **Approval of previous meeting's minutes –** July 9, 2024

4. **Old Business**
   a. Discussion and consideration of commercial bulk container services
   b. Discussion of island wide beach monitoring and surveying

5. **New Business**

6. **Miscellaneous Business**
   Next meeting date:

7. **Adjournment**

Public Services & Facilities Committee Meeting
9:00am, Tuesday, July 9, 2024
1207 Palm Boulevard, Isle of Palms, SC and
broadcasted live on YouTube: https://www.youtube.com/user/cityofisleofpalms

MINUTES

1. **Call to Order**

   Present: Council members Miars, Hahn, Pierce

   Staff Present: Administrator Fragoso, Director Kerr, Director Pitts, Director Ferrell, Asst. Director Asero

   Also present: John Griffith, Jr., Brian Kessler

2. **Citizen's Comments -- none**

3. **Approval of Previous Meeting's Minutes – June 4, 2024**

MOTION: Council Member Pierce made a motion to approve the minutes of the June 4, 2024 meeting. Council Member Hahn seconded the motion. The motion passed unanimously.

4. **Old Business**

Discussion regarding City Hall building assessment, renovation and expansion options to consider

John Griffith, Jr. of Trident Construction and Brian Kessler of McMillan Pazden Smith joined the Committee to discuss the options for a new City Hall in Municipal Lot B or adjacent to the Public Safety Building. Four options were presented for discussion: City Hall fully attached to the Public Safety Building, City Hall partially attached to the Public Safety Building, a free-standing building with an adjacent parking garage in Municipal Lot B, and a free-standing building with parking underneath along the Ocean Boulevard edge of Municipal Lot B.

Mr. Griffith and Mr. Kessler shared the construction challenges involved with attaching City Hall to the current Public Safety Building. The costs and disruptions will be higher when attaching to another building. A City Hall adjacent to Public Safety would be a less expensive option but adds new parking requirements. Director Kerr and Director Pitts added that underground utility work would need to be done in the area if this is the selected option. Both options would prevent the Fire Department from having drive-through ability in the bay. Council Member Hahn said he likes the "synergy" created by having City Hall adjacent to Public Safety. Creating a "Welcome Center" type of entry was discussed. Director Kerr pointed out that this option allows the City to use Municipal Lot A for parking without restrictions.

It was noted that the deed restrictions on Municipal Lot B will need to be addressed with SCPRT if the City decides to move forward with the use of this lot for a new City Hall. Director Kerr said the deed is not tied to the number of parking spots provided but there must be an "offset of equal market value" for the space they may use for a new building.

Administrator Fragoso pointed out that adding a large amount of parking in that area in the form of a parking garage may not be the best option as the beach at high tide cannot accommodate a large number of people. Mr. Griffith said the cost of a parking garage could be approximately $8 million.

Discussion ensued about the pros and cons of a smaller footprint, two-story City Hall with parking underneath within Municipal Lot B. Mr. Griffith said a building fronting Ocean Boulevard could provide more visibility and "visitor center presence." Council Member Pierce suggested looking into grant funding available for municipal complexes. Administrator Fragoso said that tourism funds can be used for the creation of visitor centers.

After further discussion, Mr. Griffith said they would return to the August Committee meeting with more data including a drone flyover of Municipal Lot B on July 17 (a day the City anticipates heavy usage of Lot B) and clearer cost potentials for a City Hall adjacent to the Public Safety Building and a City Hall fronting Ocean Boulevard with parking underneath. Staff will also research additional funding sources for this project.

5. **New Business**

A. **Discussion and consideration of commercial bulk container services**

Administrator Fragoso reviewed the situation: "The City has been historically paying for the collection of commercial bulk containers islandwide and that includes brick and mortar businesses and condominiums. The current vendor increased the price from approximately $.75/yard to $3 starting June 1. I think that there was a change in ownership. This has been the price the City has been paying for over 18 years, more that that, and that got increased. We received the note in May that that was the new price starting in June. We went up from an annual cost of about $75,000 a year to $3 to $188,000. Like I said, the City has been paying for this. We believe this started after Hugo to help struggling businesses after the hurricane, but that is just speculation on our part. It has been an ongoing service. We are not aware of any other municipality in the state that pays for bulk container collection for businesses, and the volume has increased dramatically over time. We see a lot of activity on the island. Our businesses are thriving, and with that comes just a lot of generation of garbage."

Administrator Fragoso shared some options for the Committee to consider:

-City continues paying for commercial collection services for businesses and condominiums at an annual cost of $2.50/yard or $250,000

-City continues to pay for commercial collection services for business and condominiums for 6 months and phase this service out to be the responsibility of the businesses at a cost of $3.75/yard or $180,000 with the current provider

If the City wants to cover the cost of the collection services for the condominiums, the City could contract with a low bidder to provide the service for 6 months. This would provide time for a new vendor to purchase new bins and install them. The annual cost for the City to continue to pay for the pickup of commercial bulk containers at the condominiums would be $95,000.

Administrator Fragoso said that due to the significant change in scope from the original RFB, the City would provide all respondents the opportunity to provide a sealed bid for the cost of servicing the condominiums to guarantee the lowest price per yard for the City.

Additional considerations need to be discussed regarding the municipal compactor. Currently, ten Front Beach businesses use the compactor as they do not have the space to accommodate a commercial dumpster on their property. The City bills each business for their use of that compactor. One potential downside of passing commercial bulk container collection costs to the Front Beach businesses who currently use the compactor is that they may request to use the 96-gallon roll carts serviced by Public Works, which would impact the efficiencies of island wide garbage collection.

Council Member Pierce said two issues need to be dealt with: "getting a currently market-based contract with our provider who is going to take the dumpsters and haul the dumpster trash. And then we have got the policy on where we are going to pick up and not pick up on behalf of the City and what we are going to pass off."

Administrator Fragoso said the option with the most flexibility is signing a 6-month contract for commercial bulk pickup which gives the Committee and City Council the time to figure out a new policy, secure a provider, and give them time to get their dumpsters in place.

Council Member Pierce would like to see a breakdown in costs related to servicing condominiums, servicing the compactor, as well as costs for the City over a three-year period.

Administrator Fragoso pointed out that the City already has a collection system in place since they bill Front Beach businesses for the use of the compactor.

Council Member Miars asked if there was a way to require all Front Beach businesses to use the compactor as some of them use the roll carts collected by Public Works.

Administrator Fragoso said, "City code establishes that any location that use or any commercial business that uses more than two 90-gallon containers could be required by the Public Works Director to get a bulk container."

She also pointed out that there is no incentive for businesses to minimize or recycle more of their trash.

MOTION: Council Member Pierce made a motion to recommend to City Council moving forward with a 6-month contract at $3.75/yard. Council Member Miars seconded the motion.

Director Kerr said policy decisions need to be made quickly so that changes can be communicated to the businesses and the new vendor, if there is a change, will have time to

secure and place the dumpsters. Council Member Pierce said this issue should be on the agenda for the July 23 Council meeting while staff continues to work on the billing process.

VOTE: **A vote was taken as follows:**

Ayes: Pierce, Miars
Nays: Hahn

The motion passed 2-1.

B. **Discussion of miscellaneous and yard debris collection services**

Referencing a one-page document in the meeting packet, Administrator Fragoso said staff is proposing an ordinance change for miscellaneous and yard debris collection. The current ordinance states this trash is to be taken up on Wednesdays. However, Public Works is picking it up most afternoons because of the volume being produced and it affects their workflow. If a resident puts out a lot of debris at one time, it becomes very time consuming for Public Works to tend to it. Administrator Fragoso said that the use of City time as well as aesthetics needs to be addressed.

Staff is proposing a scheduled pick-up day for various parts of the island:

Collection Schedule Yard Debris:
Mondays – Breach Inlet through 14th Avenue
Tuesdays – 15th Avenue through 30th Avenue
Wednesdays – 30th through 42nd Avenue
Thursday – Wild Dunes
Friday – 42nd Avenue through 57th Avenue
Miscellaneous - Wednesdays – Island wide

Administrator Fragoso said this will require a change to City code and time to communicate the changes to the residents. She would like to have it in place before next season.

Enforcement of such a change was also discussed. Director Kerr said that it is currently easier and faster for Public Works to pick up the debris than it is to call Code Enforcement to have them address it first. Director Pitts said including Code Enforcement is important so that Public Works is not blamed for debris not being picked up.

This issue will be brought to the attention of the full Council at the August workshop.

C. **Discussion of beach garbage collection services**

Administrator Fragoso said the current beach garbage collection contract ends next September, and she would like to get ahead of any changes that may need to be made to the contract prior to issuing the RFP. The current contract holder died unexpectedly and his son is currently fulfilling the terms of the contract. She will be speaking to him to understand his future plans.

Considerations for a new contract could include the pickup of large debris left behind by beachgoers, whether or not garbage cans should be on the beach, should the cans be lidded, should the cans be moved off the beach, etc.

Administrator Fragoso noted that unlidded trashcans have led to a lot of trash on the beach and the coyotes rummaging the cans in search of food. She would like the Environmental Advisory Committee to discuss the issues involved with the trashcans and provide feedback to the Committee.

Director Pitts added that there were originally only 57 trashcans, one per block, and now there are over 200 cans across the island. He said a vendor dedicated to emptying these cans is needed because the bulk of the trash is generated over the weekends.

Administrator Fragoso said staff would like to pick one avenue, build a trashcan corral, and move the cans off the beach as a test to monitor beachgoer behavior with regards to trash disposal. She said removing the trashcans from the beach provides a built-in redundancy in storm preparations as the cans must be removed from the beach as a storm approaches.

Recommendations from staff and the Environmental Advisory Committee will be brought back to the Committee for further discussion.

D. **Discussion of island wide beach monitoring and surveying**

Committee members discussed whether or not to put out an RFP for the beach monitoring services contract with CS&E that is set to expire this year. Administrator Fragoso said a new contract will include more frequent beach monitoring as suggested by the Beach Preservation Ad Hoc Committee.

It was decided that an RFP would be put out with the intention of bringing the bids back to the City Council workshop in August.

6. **Miscellaneous Business**

The next regular meeting of the Public Services & Facilities Committee will be Tuesday, August 13, 2024 at 9am.

7. **Adjournment**

Council Member Pierce made a motion to adjourn and Council Member Miars seconded the motion. The meeting was adjourned at 11:19am.

Respectfully submitted,
Nicole DeNeane
City Clerk

City of Isle of Palms
Detail List of Dumpsters

Name of location	Commercial or Condos	R=recycle G=garbage	(A) Size in Yards IN YARDS	(B) # of Containe at Location CONTAINERS	(C) Days Serviced per Week									$ 2.50
			Size of can	Number of cans	Number of days serviced	Yards per week	Yards per month	Price per yard		Current Aveage Cost Per Month		New Aveage Cost Per Month	
Acme Cantina	Commercial	G	8	1	4	32	138.56	$	0.58	$	79.99	$	346.40
Acme Cantina	Commercial	G	6	1	4	24	103.92	$	1.01	$	105.00	$	259.80
Broadwalk Inn	Commercial	G	4	2	3	24	103.92	$	0.34	$	35.53	$	259.80
Broadwalk Inn	Commercial	G	4	1	3	12	51.96	$	0.68	$	35.53	$	129.90
Boat House Restaurant	Commercial	G	8	1	5	40	173.2	$	0.65	$	112.91	$	433.00
Citadel Beach House	Commercial	G	6	1	2	12	51.96	$	0.65	$	33.98	$	129.90
Ocean Park Center	Commercial	G	8	1	5	40	173.2	$	0.65	$	112.91	$	433.00
Links Clubhouse/Edgar's	Commercial	G	4	1	2	8	34.64	$	0.88	$	30.45	$	86.60
Links Clubhouse/Edgar's	Commercial	G	8	1	2	16	69.28	$	0.65	$	44.94	$	173.20
Links Golf Course	Commercial	G	30yd R/O	1	on call	rent $111.:	Haul $194.76			$	510.71	$	305.94
Links Golf Course	Commercial	G	8	1	1	8	34.64	$	0.66	$	23.02	$	86.60
Long Island Café	Commercial	G	4	1	3	12	51.96	$	0.65	$	33.98	$	129.90
Long Island Café	Commercial	R	6	1	3	18	77.94	$	0.63	$	49.33	$	194.85
Lutheran Retreat Center	Commercial	G	8	1	1	8	34.64	$	0.65	$	22.68	$	86.60
Kangaroo (Circle K)	Commercial	G	8	1	2	16	69.28	$	0.90	$	62.64	$	173.20
Kangaroo (Circle K)	Commercial	R	8	1	3	24	103.92	$	0.43	$	44.28	$	259.80
Post Office	Commercial	G	6	1	1	6	25.98	$	0.67	$	17.28	$	64.95
Sea Biscuit Café	Commercial	G	2	1	2	4	17.32	$	0.69	$	11.88	$	43.30
The Co-Op	Commercial	G	6	1	2	12	51.96	$	0.67	$	34.56	$	129.90
The Refuge	Commercial	G	6	1	2	12	51.96	$	0.68	$	35.08	$	129.90
Beachside Vacations	Commercial	G	8	1	5	40	173.2			$	-	$	433.00
Wild Dunes Housekeep	Commercial	G	8	2	2	32	138.56	$	0.31	$	43.20	$	346.40
Wild Dunes Housekeep	Commercial	R	8	1	2	16	69.28	$	0.31	$	21.60	$	173.20
Liquor Store	Commercial	G	6	1	2	12	51.96	$	0.62	$	32.03	$	129.90
Palm Blvd/ IOP LLC	Commercial	G	4	1	3	12	51.96	$	0.65	$	33.98	$	129.90
Charleston County Park	Commercial	G	6	1	3	18	77.94	$	0.84	$	65.77	$	194.85
Charleston County Park	Commercial	G	6	1	4	24	103.92	$	0.61	$	63.58	$	259.80
Wild Dunes Beachhouse	Commercial	G	6	1	2	12	51.96	$	0.64	$	33.48	$	129.90
Marina Outpost	Commercial	G	8	1	5	40	173.2	$	0.65	$	112.91	$	433.00
The Villages at Wild Dunes	Commercial	G	4	11	5	220	952.6	$	0.62	$	594.00	$	2,381.50
The Villages at Wild Dunes	Commercial	R	4	3	5	60	259.8	$	0.62	$	162.00	$	649.50
Wild Dunes Sweetgrass Pavilion	Commercial	R	4yd Comp	1	1	12	51.96	$	0.67	$	35.00	$	129.90
Wild Dunes Sweetgrass Pavilion	Commercial	R	4	2	3	24	103.92	$	0.67	$	70.00	$	259.80
Wild Dunes Sweetgrass Pavilion	Commercial	G	4	3	3	36	155.88	$	0.45	$	70.00	$	389.70
Sweetgrass Inn	Commercial	R	4	1	3	12	51.96			$	-	$	129.90

Sweetgrass Inn	Commercial	G	4	5	6	120	519.6		$ -	$ 1,299.00
Islander 71	Commercial	G	8	2	5	80	346.4	$ 0.65	$ 225.82	$ 866.00
Municipal Compactor in Lot B	Commercial	G	30 yd Comp	1	2x/week		Haul $184.78		$1,515.44	$1,847.80
Recreation Dept	Condo	G	6	1	1	6	25.98	$0.67	$17.28	$64.95
1140 Ocean Blvd. Condos	Condo	G	8	1	3	24	103.92	$0.64	$66.42	$259.80
Ocean Club Villas	Condo	G	4	8	3	96	415.68	$0.66	$273.24	$1,039.20
Ocean Inn	Condo	G	4	1	1	4	17.32	$1.31	$22.72	$43.30
Sea Cabins Condos	Condo	G	8	4	3	96	415.68	$0.86	$358.56	$1,039.20
Seascape Condos	Condo	G	8	2	2	32	138.56	$0.64	$88.56	$346.40
Seaside Villas	Condo	G	8	2	3	48	207.84	$0.64	$133.92	$519.60
Shipwatch Condos	Condo	G	8	4	3	96	415.68	$0.64	$267.84	$1,039.20
Summerhouse Condos	Condo	G	8	2	3	48	207.84	$0.64	$133.92	$519.60
Tidewater	Condo	G	8	2	2	32	138.56	$0.64	$88.56	$346.40
Port O Call I	Condo	G	8	1	3	24	103.92	$0.64	$66.96	$259.80
Wild Dunes Yacht Harbor	Condo	G	8	1	2	16	69.28	$0.64	$44.28	$173.20
Mariners Walk	Condo	G	8	1	1	8	34.64	$0.66	$23.00	$86.60
Mariners Walk	Condo	G	4	3	1	36	155.88	$0.85	$132.84	$389.70
Seagrove Villas	Condo	G	4	2	3	24	103.92	$0.68	$70.67	$259.80
			312	95	143	1688	7309.04		$ 6,304.26	$ 20,426.34
									$ 75,651.08	$ 245,116.08

FY23	$ 75,305.64
FY24 Estimate	$ 107,959.43
Increase from FY23 to FY 24	$ 0.43
Increase from FY24 to FY25 Projection	$ 1.27

Cost by Type of Property	**Monthly**	**Annual**
City OR Condos	$ 8,234.55	$ 98,814.60
Commercial	$ 12,191.79	$ 146,301.48

City of Isle of Palms, SC
Request for Proposals 2024-06
Island Wide Beach Monitoring

Bid Opening - 10:00 a.m., August 9, 2024

Douglas Kerr announced the sealed bid opening of RFP 2024-06. The RFB was advertised in accordance with the City's Procurement Code.

Proposals Received:

Proposer	Planning, Communication and Liason	Semi Annual Beach Condition Survey	Semi Annual Aerial Photography	Semi Annual Report	In Office and Direct Expenses	Total
Coastal Science & Engineerin	$ 13,560	$ 37,160	$ 7,200	$ 29,960	$ 18,120	$ 106,000

The proposals will be evaluated for accuracy and compliance with the specifications defined in the RFB. A recommendation for award of a contract will be made to City Council.

Island Wide Beach Monitoring
Isle of Palms, SC

RFP#2024-06

Proposal

Presented by:

COASTAL SCIENCE & ENGINEERING
High Value Services. Sustainable Solutions.

Contents

Cover Letter

RE: RFP#2024-06 – Island Wide Beach Monitoring

Coastal Science & Engineering, Inc. (CSE) is pleased to present this proposal to the City of Isle of Palms for island-wide beach monitoring services.

The City seeks a consultant to conduct semi-annual surveys of the beach and inshore zone, provide mid-year executive summaries of survey data, and prepare yearly comprehensive monitoring reports. This ongoing analysis of beach volume changes will support the City's long-term coastal management and conservation efforts.

How We Can Help

CSE's 40 years of experience serving the Isle of Palms with coastal management planning, beach nourishment solutions, and beach profile monitoring offers a unique fit for this undertaking. We can assist the City by performing the following services:

- Liaison with City representatives to schedule field surveys and prepare periodic project summaries (including graphics and web updates).
- Semi-annual surveys of the downcoast area of the island (Breach Inlet to 53rd Avenue).
- Semi-annual surveys of the Dewees Inlet ebb-tidal delta.
- Semi-annual surveys of the Breach Inlet ebb-tidal delta.
- Mid-year executive summaries of survey data.
- Annual comprehensive monitoring reports documenting beach volume changes and nourishment performance.

Why We Are Well-Positioned to Perform Beach Monitoring Services for the City

CSE brings the longest history of beach monitoring in South Carolina to the proposed project.

- We have been involved with shoreline management at the Isle of Palms for 40 years.
- CSE has more experience surveying and analyzing South Carolina beach volume changes than any other entity.
- The quality of our work is reflected in long working relationships with several coastal communities, including Edisto Beach (25+ years), SC Department of Park, Recreation, and Tourism (30+ years), Seabrook Island (40 years), and Kiawah Island (15+ years).
- CSE has been contracted by SCDHEC–OCRM for the past 12 years to complete annual surveys of the state-wide beach monitoring network of ~400 profiles.

Over the past 17 years, CSE has worked for the City in all aspects of beach management, including surveys similar to those detailed in the RFP, permitting and execution of beach restoration projects, hurricane response, coastal policy, education, and outreach. CSE recently completed a contract for annual monitoring through 2023. Selecting CSE for additional island-wide monitoring will allow for seamless data collection, which provides an improved product, more accurate analysis, and reduces impacts to beachgoers. Over the past 17 years, CSE has learned the specific needs and expectations of the City and tailors our reports and communication products to those needs.

Thank You for Reviewing our Proposal

The proposal is organized according to the items requested in the RFP:

- Company Profile
- Methodology and Anticipated Scope of Work
- Key Project Team Personnel
- Project Budget and Cost Breakdown
- Client References
- Oath of Non-Collusion
- Statement Regarding Pending Legal Actions
- Appendices – Resumes & Equipment Information

Should you have any questions about our response to the City's Request for Proposals for island-wide beach monitoring services, please call (803) 799-8949 or email straynum@coastalscience.com.

CSE has had the pleasure of assisting the Isle of Palms for 40 years and is committed to continuing that relationship by providing the services herein to support the City's coastal management goals. We sincerely hope the City selects our team for the work included in RFP#2024-06, and we look forward to continue serving the City Council, residents, and visitors of Isle of Palms.

Thank you for your consideration.

Steven Traynum
President, Senior Project Director

Company Profile

Section B – Company Profile

The following section outlines the combined coastal management expertise of the CSE project team.

B.1. Company Background

Coastal Science & Engineering Inc. operates in the State of South Carolina as a registered **Engineering** firm with LLR South Carolina State Board of Registration for Professional Engineers and Surveyors with current registration from 2021 to 2023 (COA #1950). CSE's President Emeritus, Dr. Tim Kana (Lic #564) and Dr. Patrick Barrineau (Lic #2773), are also actively registered professional geologists with the LLR South Carolina Board of Registration for Geologists.

CSE specializes in engineering, planning, and scientific studies in the coastal zone. Since 1984, our experts in coastal and environmental engineering, geology, oceanography, and surveying have developed innovative engineering solutions to problems related to changing coastlines. CSE has in-house capabilities and experience to provide turn-key beach management services in conducting the following engineering work:

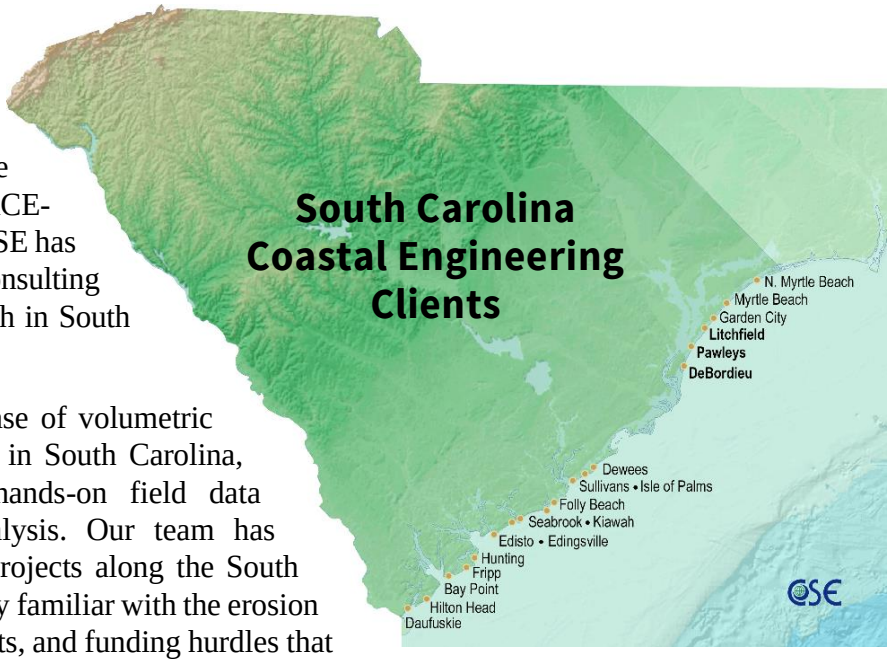
- Shoreline erosion assessment and feasibility studies
- Developing local and/or regional short-term and/or long-term beach management plans
- Community outreach and education
- Coastal shoreline numerical modeling and alternatives analysis
- Topographic mapping and bathymetric surveys from the beach zone to deep water
- Inland and offshore sand searches and geotechnical studies
- Project cost analysis to assist the client with public financing and planning
- State and federal permitting, environmental compliance, and documentation
- FEMA coordination and cost estimation for public assistance funds
- Development of plans and specifications for construction
- Bidding and negotiating with contractors
- Construction Administration
- Post-project monitoring to evaluate project performance

Among CSE's Milestone Are:

- A total of 55 large-scale nourishment projects (~42 million cubic yards) via hydraulic dredge, hopper dredge, truck hauling from inland and offshore sources, sand transfers from accreting zones, and inlet relocation/realignment. These projects have helped protect property worth over $15 billion.
- Five projects have been recognized as Best Restored Beaches by the American Shore & Beach Preservation Association (ASBPA), including Sagaponack– Bridgehampton, NY (awarded 2018), Seabrook Island, SC (2016), Folly Beach County Park, SC (2015), Nags Head, NC (2013), and Isle of Palms, SC (2011).
- The 2011 Nags Head (NC) project was the largest locally funded nourishment project ever constructed in the US at 4.6 million cubic yards and received an ACEC National Engineering Excellence Award in 2013.
- CSE's innovative relocation of Captain Sams Inlet (SC) was recognized by the National Academy of Sciences as *"both environmentally sensitive and cost-effective, indicating the benefits of combining fundamental research on coastal processes with coastal engineering practices."*
- Developed methodology for establishing objective setback lines for development in South Carolina (enacted as part of the State's Beach Management Act in 1988).
- Consultant to the federal government (eg – US Army Corps of Engineers, US Environmental Protection Agency), state government (South Carolina, North Carolina, Georgia, and New York), and numerous municipal governments throughout the Carolinas.

Extensive South Carolina Beach Management Experience

CSE is the most experienced beach nourishment design firm in South Carolina, with more project experience than the USACE-Charleston District. Since 1984, CSE has provided engineering or consulting services for every developed beach in South Carolina.



CSE maintains the largest database of volumetric and linear erosion measurements in South Carolina, developed over 35 years of hands-on field data collection and aerial photo analysis. Our team has conducted over 40 engineering projects along the South Carolina coastline and is intimately familiar with the erosion challenges, regulatory requirements, and funding hurdles that local coastal communities face.

Long-term Client Relationships Based on Responsive Service

CSE aims to be the coastal engineering consultant that establishes long-term relationships with clients by performing highly competent services with integrity, responsiveness, and dedication to solutions. The quality of the services CSE provides is reflected in the large number of long-term clients that we serve. *Examples Include:*

- **1984-Present – Seabrook Island, SC (Town and Property Owners Association)**
  - ✓ CSE principals established the initial beach monitoring plan.
  - ✓ Developed the designs for three (3) inlet relocation projects, beach nourishment, and periodic sand recycling.
  - ✓ Provided permitting services for all major beach restoration work (for the POA).
  - ✓ Served as an advisor to the Town of Seabrook for their local Beach Management Plan (1991 and 2014).
  - ✓ CSE conducts annual beach monitoring surveys for the community using an extensive network of profiles into deep water and related digital terrain mapping and modeling.

- **1984-Present – City of Myrtle Beach, SC**
  - ✓ CSE set up the initial beach monitoring network of profiles along the nine-mile beach and monitors an expanded network each year to track the performance of beach nourishment projects.
  - ✓ Prior to the Federal 50-year Storm Damage Reduction Project (1997-2041), CSE designed and managed two interim nourishment projects, which were credited with significantly reducing property damages from major northeasters and Hurricane *Hugo* (1989).
  - ✓ CSE coordinates the City's annual surveys closely with the US Army Corps of Engineers.

- **1989-Present – Hunting Island and Edisto Beach, SC (SC Dept. of Parks, Recreation, and Tourism)**
  - ✓ Principal consulting engineering consultant to the SC Department of Parks, Recreation, and Tourism (PRT).
  - ✓ Designed five (5) beach restoration projects (1991, 2006 (2), 2017, and 2020) totaling ~3.0 million cubic yards (cy).
  - ✓ The 2006 and 2020 restoration projects at Hunting Island also included the construction of eight (8) low-profile groins designed to reduce erosion to less than one-third of the historic erosion rate and create safe swimming beaches for visitors.
  - ✓ CSE monitors the beach and borrow areas each year to track project performance.

- **1990-Present – Town of Edisto Beach, SC**
  - ✓ 30+ years of experience evaluating alternative erosion mitigation strategies for a complex setting with highly variable erosion rates, time-varying impacts of groins, and an unusually coarse-grained beach with high shell content.
  - ✓ Design of large-scale nourishment projects (2006 and 2017).
  - ✓ Development of innovative designs to improve a groin field dating back to the 1950s, including concomitant nourishment (1995).
  - ✓ Performance monitoring by annual beach surveys, offshore sand searches, and borrow area recovery surveys.
  - ✓ Assisted with the development of a Local Comprehensive Beach Management Plan.

- **Other Coastal Communities Where CSE has Long-term Relationships**
  - ✓ Isle of Palms, SC (1984-Present)
  - ✓ Debidue Island, SC (1985-1998; 2015-Present)
  - ✓ Town of Southampton, NY (2011-Present)
  - ✓ Town of Nags Head, NC (2003-2019)
  - ✓ Dare County, NC (2013-Present)
  - ✓ The State of South Carolina (SCCC and OCRM) (1984-1992; 2006-Present)

B.2. Relevant Project Experience

CSE's professional staff includes experienced specialists in coastal engineering, geology and geomorphology, numerical modeling, environmental science, and coastal oceanography. With graduates from prestigious programs in these fields, our team offers a broad perspective and experience in a wide range of settings. CSE takes great pride in preparing practical designs that work with nature. We bring a common-sense approach to projects based on decades of experience among our senior staff.

Much of CSE's success with beach nourishment projects is related to the hundreds of shoreline erosion assessments our professionals have completed in many different settings worldwide. This comprehensive view of the controlling coastal erosion processes helps our team quickly identify the principal erosion factors at a site.

The combination of numbers of projects executed, shoreline studies completed, and years of experience in the coastal zone makes CSE uniquely qualified to develop sound coastal engineering solutions. We take pride in the high standards that we bring to projects and the enthusiasm and dedication of our staff to clients' needs. Principals and staff engineers/scientists perform field data collection; CAD personnel serve as divers; administrative staff performs important client liaison; and so on.

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Shoreline Assessments

CSE's staff has completed detailed shoreline assessments at hundreds of sites in a wide range of settings from the tropics to high latitudes. Studies have been conducted along micro-, meso-, and macro-tidal shorelines with a range of wave climates and fetches. CSE scientists have published numerous peer-reviewed papers on coastal erosion, littoral sediment budgets, shore protection, and predictions of sea-level-rise impacts. Shoreline assessments are a critical first step in the evaluation of sites for coastal development. CSE's worldwide experience in a range of settings allows the development of efficient and cost-effective data collection plans that focus on the primary factors controlling the site's evolution. Following are examples of CSE's shoreline assessments.

- Erosion assessment, project design, and construction management for the Town of Nags Head (NC) $32 million beach nourishment project.
- Design and construction management of beach restoration project for Bogue Banks in Carteret County (NC), including completing a $19 million beach nourishment project in two phases.
- SCDHEC-OCRM – Inventory of historical erosion rates for all developed beaches in South Carolina
- Shoreline assessment, design, and construction management for a $4.5 million beach nourishment project in Myrtle Beach (SC).
- Shoreline assessment and determination of 30-year development setbacks for Palmetto Dunes, Hilton Head Island (SC).
- Beach management plan and recommended beach nourishment projects for Brevard County, Florida.
- Consultant to the South Carolina Coastal Council (SCCC) [now SCDHEC's Office of Ocean and Coastal Resource Management (OCRM)] on storm damage and erosion control strategies for the Grand Strand.
- Analysis of statewide beach-profile data collected by universities for the state of South Carolina. CSE has been OCRM's contractor for the program since 2014.
- Inland sand search for beach nourishment material along the South Carolina Grand Strand.
- Annual beach monitoring and analysis for Kiawah Island, Seabrook Island, Debidue Island, and Isle of Palms (SC).
- Development of a coastal-sediment-transport and oil pollution model (Alaska) for the U.S. Minerals Management Services (now BOEM).
- Engineering/environmental design for resort waterfront (~225 acres) in Dubai, Kuwait.
- Shoreline-erosion analysis, computer-based water-flow study, and wetlands management plan for Debidue Island (SC).
- Erosion assessment and beach restoration plan for a 900,000 cubic yard nourishment project at Isle of Palms (SC).
- Determination of erosion causes and formulation of mitigation measures for the Town of Hilton Head Island (SC).
- Prediction of 25- and 50-year future shorelines for development setback planning for Myrtle Beach (SC).
- Beachfront management plan, including a detailed inventory of conditions for North Myrtle Beach (SC).
- Shoreline erosion analysis (due to wind) for Atlantic City (NJ).
- Shoreline assessment and erosion mitigation strategy for Dewees Island (SC).
- Regional volumetric erosion rates for nine barrier islands in the Charleston (SC) Bight.
- Regional sediment budget for Montauk Point to Jones Beach, Long Island (NY) for the New York District USACE.
- Shoreline assessment and plan for beach restoration via inlet channel realignment at Seabrook Island (SC).
- Study of beach dynamics and the monsoon cycle, Oman, Arabian Gulf.
- Shoreline erosion assessment and preliminary design for beach restoration at Quogue (NY).

Hydrographic, Topographic, and Orthophotography Data Collection

CSE has extensive experience in quantitative hydrography and hydraulics, bathymetric data collection, drone-acquired orthophotography, and sediment measurements in the coastal environment. Following are sites where CSE personnel have first-hand experience with physical process and bathymetric measurements. CSE has surveyed many of these locations numerous times as part of nourishment design and monitoring projects. *Denotes locations with OCRM stations monitored by CSE.

CSE Survey Locations	
* Waties Island, South Carolina	Fripp Inlet, South Carolina
* North Myrtle Beach, South Carolina	* Fripp Island, South Carolina
* Arcadian Shores, South Carolina	Bay Point Island, South Carolina
* Myrtle Beach, South Carolina	* Hilton Head Island, South Carolina
* Surfside Beach, South Carolina	* Daufuskie Island, South Carolina
* Garden City Beach, South Carolina	Quogue, New York
* Huntington Beach State Park, South Carolina	Bridgehampton, New York
* Litchfield, South Carolina	Asharoken, New York
* Pawleys Island, South Carolina	Smith Point, New York
* DeBordieu Island, South Carolina	Fire Island, New York
* Dewees Island, South Carolina	Moriches Inlet, New York
* Isle of Palms, South Carolina	Kitty Hawk, North Carolina
Breach Inlet, South Carolina	Nags Head, North Carolina
* Sullivan's Island, South Carolina	Cape Hatteras N. Seashore, North Carolina
Charleston Harbor, South Carolina	Oregon Inlet, North Carolina
Lighthouse Inlet, South Carolina	Shackelford Banks, North Carolina
* Folly Beach, South Carolina	Harkers Island, North Carolina
Stono Inlet, South Carolina	Beaufort Inlet, North Carolina
* Kiawah Island, South Carolina	Port of Moorhead City, North Carolina
Captain Sams Inlet, South Carolina	Bogue Banks, North Carolina
* Seabrook Island, South Carolina	Bogue Inlet, North Carolina
North Edisto Inlet, South Carolina	Bear Island, North Carolina
Botany Bay, South Carolina	Bear Inlet, North Carolina
Edingsville Beach, South Carolina	Oak Island, North Carolina
* Edisto Beach, South Carolina	Lockwoods Folly Inlet, North Carolina
* Harbor Island, South Carolina	Shallotte Inlet, North Carolina
South Edisto River, South Carolina	Ocean Isle Beach, North Carolina
Saint Helena Sound, South Carolina	Jumby Bay, Antigua
* Hunting Island, South Carolina	Hopkins, Belize

Previous Project Experience

CSE has completed several hundred projects involving beach surveys, ranging from simple delineations of dune crests and mean high-water lines to dense networks of transects over ebb tidal deltas. CSE's surveys have established standards and common reference contours for wading-depth profiles, long profiles to the local depth of closure, long profiles to (~)−30 ft (USACE standard), and surveys over borrow areas. The degree of survey coverage depends on the specific requirements of each project.

CSE's field survey experience includes the preparation of the first bathymetric map of Bogue Inlet, encompassing the entire ebb-tidal delta and mid-inlet shoal areas and channels. Seabrook Island (SC) is another example of CSE's experience in preparing surveys requiring near-blanket coverage of inlet, shoal, and beach morphology. CSE and its predecessor companies, dating back to the 1970s, have conducted over 40 beach surveys along the Seabrook shoreline in connection with beach restoration projects. Recent project experiences relevant to the proposed work are described below.

Collection of Beach Erosion Monitoring Data for SCDHEC-OCRM

CSE was awarded the 2013-2014, 2015, 2016-2018, 2019-2021, and 2022-2024 Beach Erosion Monitoring Data Collection contracts for SCDHEC Division of Ocean and Coastal Resource Management (OCRM). CSE has successfully conducted the OCRM BERM data collection for the past ten years. The 2013 to 2024 data were collected and delivered to SCDHEC-OCRM in a timely manner. Data were collected at the 397 monument locations along the developed beaches of South Carolina. CSE worked closely with OCRM staff to improve the data quality of the monitoring effort, which had previously experienced inconsistent survey methods and data collection. Rigorous QA/QC procedures were developed and employed to ensure data quality, including narrow survey offsets, close spacing of data points, field notes, photos, accounting for gaps in the data, and post-processing inspections. In addition to the BERM project, CSE has also helped OCRM with various small-scale contracts over the last ten years. It has been our absolute pleasure to work with the OCRM staff, and we look forward to continuing our professional relationship as we work together to monitor South Carolina's coastline.

Beach Monitoring along Kiawah Island (SC)

The Town of Kiawah Island recently renewed (2024-2026) their sponsorship of annual shoreline monitoring surveys. The monitoring determines the rates of sand movement, accretion, and erosion in the project area and seaward side of the island (OCRM 2615 near Beachwalker Park to CSE 252+00 at Stono Inlet). These efforts follow a dozen shoreline erosion reports prepared by RPI and CSE for Kiawah Island since the 1980s (eg – Kana et al 1984, CSE 1999). Post-project surveys have been conducted yearly in early fall between September 2006 and November 2020. Profiles along Kiawah Island are surveyed perpendicular to the local shoreline (CSE baseline) azimuth from the approximate dune crest to a minimum of −12 ft NAVD (depth equal to the normal limit of sand movement in this setting) or at least 3,000 ft from the dune. CSE surveys 65 stations along the length of Kiawah Island. Twenty-three (23) of these stations are OCRM stations (2615-2730) and encompass the beach downcoast of the 2006 project area. The remaining 64 stations are spaced 400 ft apart, follow the 2006 project baseline, and encompass the Ocean Course, incipient lagoon, and Stono Inlet shorelines.

Monitoring and Analysis of the 1997, 2017, and 2019 Myrtle Beach Shore Protection Projects

The City of Myrtle Beach retained CSE in 2001 to complete annual shoreline monitoring of the 1997 shore protection project – Reach 2 (9.23-mile length of ocean shoreline between 82nd Avenue North and 29th Avenue South). The 21st annual study, focusing on the 2008 and subsequent 2017 & 2019 USACE nourishment project (CSE 2021), was completed by CSE for the City and the US Army Corps of Engineers (USACE). The City of Myrtle Beach recently awarded CSE with the current monitoring contract for the years 2021-2025. Project monitoring is performed to track the performance of beach nourishment and document the movement of sand out of the nourishment area. Monitoring provides estimates of shoreline movement trends and identifies areas of erosion and accretion after nourishment, providing important design guidance for future beach projects. The City's surveys take place annually in May/June and include 26 OCRM lines and 45 additional lines established by CSE. Completion and submission of survey observation forms and annotated photographs are also part of the monitoring. Results of the Myrtle Beach monitoring program have been summarized in professional articles and presented at national conferences such as ASCE's conference on Coastal Engineering Practice San Diego 2011.

Beach Monitoring of the 2006 and 2017 Edisto Beach Nourishment Projects

CSE currently (contracted 2018-2022) conducts annual post-project monitoring surveys following the 2006 and 2017 Edisto Beach nourishment projects, which placed over 850,000 cubic yards (cy) of offshore sand on the beachfront. The monitoring effort provides a current status of the beach, including changes in sand volume compared to pre-nourishment and post-nourishment conditions. It serves as an up-to-date reference for pre-storm conditions in the event of a major storm event directly impacting Edisto Beach. The monitoring involves the collection of beach profiles at permanent monuments established by OCRM along the South Edisto River shoreline and the state park and three profiles per groin cell along the Town's beachfront. Extra lines within each groin cell allow evaluation of fillet development under northerly and southerly waves. CSE has monitored the shoreline for the Town of Edisto Beach since the early 1990s.

Edisto Beach Offshore Sand Search Project

CSE was retained by HDR One Company (Charlotte NC) to provide a detailed bathymetric survey covering the offshore area in the vicinity of Edisto Beach, Edingsville Beach, and Botany Bay Island from St Helena Sound to the North Edisto River. The services supported the USACE (Charleston District) feasibility study for the nourishment of Edisto Beach and Edingsville Beach (Colleton County SC). It included detailed bathymetric and geotechnical data of the large shoal on the north side of the South Edisto River Inlet (CSE 2008). The general purpose of the study was to locate ~20 million cubic yards of beach-quality sand sufficient for up to 50 years of initial and future renourishment along Edisto Beach and Edingsville Beach. The bathymetric survey was conducted over a 33,000-acre region between ~2,000 ft and 24,000 ft from Edisto Island. A survey grid was constructed with shore-parallel line spacing of 1,500 ft (1,000 ft for the two most landward lines) and shore-perpendicular spacing of 500 ft totaling ~700 miles of planned surveying.

Post-Project Monitoring of the 2008 and 2018 Isle of Palms Beach Restoration Projects

As part of an annual monitoring agreement with the City of Isle of Palms (currently under contract for 2019-2023) following completion of the 2008 and 2018 nourishment projects, CSE established and monitors ~130 profiles along the length of the island. The monitoring program was built on previous studies by CSE at Isle of Palms dating to the 1980s. Profile spacing in the nourishment project area (north of 53rd Avenue) is 200 ft and increases to no more than 1,000 ft in other areas of the island. Inlet shoals on either side of the island are surveyed in detail to map the movement of channels and sandbars. Profiles along the northeastern end extend up to 15,000 ft from the baseline to fully account for changes in the inlet and its associated ebb-tidal delta. The monitoring program includes a total of nearly 220 miles of planned survey lines. Since 2007, CSE has completed thirteen (16) monitoring events at Isle of Palms (some of which were limited to the project area and included ~85 profile lines).

Seabrook Island Annual Surveys

CSE has produced a series of annual beach monitoring reports for Seabrook Island since the first relocation of Captain Sam's Inlet in 1983. Since 1990, annual surveys have been performed at ~25 transects between Camp St Christopher and Oystercatcher. Some of these transects (CSE-0 through CSE-8) date back to the late 1970s. The remaining transects (2500 series) were established by OCRM. The surveys document rates of inlet migration and allow the community to identify developing erosional hotspots associated with channel encroachment, changes in offshore shoals, or other interruptions of longshore transport. CSE has been contracted by the Seabrook POA for biannual monitoring for 2019-2024.

Hunting Island Post-Project Monitoring

CSE has monitored a series of up to 61 beach profiles at Hunting Island since 1988, including before and after nourishment conditions. CSE designed a restoration project that included nourishment and placement of six groins to combat erosion in the most widely used areas of the park in 2006-2007 and has monitored the beach each year since. SCPRT contracted CSE to conduct a beach renourishment project which was completed in early 2020 with the addition of two new groins. CSE was retained for monitoring this year (2021) and is currently awaiting the release of the future monitoring RFP. Annual reports detailing sand volume change are submitted to the state park service (and OCRM) each year.

Pawleys Island Annual Monitoring

Approximately 83 beach profiles established by CSE have been monitored dating back to 1997 at Pawleys Island. CSE has recently been under contract from 2016 to 2021 monitoring those same transects annually as well as separate post-storm surveys following Hurricane Joaquin (2015), Matthew (2016), Irma (2017), Florence (2018), Dorian (2019), and Isaias (2020). The Town of Pawleys Island has a renewed commitment to monitoring and documenting the condition of the beach, particularly following the beach renourishment project of 2020 in which CSE provided engineering services. FEMA's post-storm public assistance funds provide reimbursement for emergency renourishment of actual sand volumes lost due to major storms. Collecting annual beach monitoring data is critical to making a determination of the volumes of material that qualify for reimbursement and they also demonstrate to OCRM that the Town has an ongoing beach management plan and budget in place.

CSE's Commitment to Isle of Palms

Since 2007, CSE has had an ongoing working relationship with the Isle of Palms. This work has included design, permitting, and execution of two nourishment projects totaling over 2.5 million cubic yards of sand, execution of two shoal-management projects, over a dozen annual surveys, three post-hurricane surveys, emergency coordination, and regular communication and support of the community's interests related to the beach beyond the scope of typical beach monitoring services. CSE's team members have developed beneficial working relationships with the City staff, as well as with representatives from the Wild Dunes community, local residents, elected officials, and regulatory agencies. These relationships have proven beneficial in implementing beach management strategies quickly and with the support of the community. CSE regularly attends City Council and committee meetings to provide updates on beach management activities and is available on short notice to provide ongoing consulting work for the City (all within existing contract budgets). Since 2007, CSE has performed all services for the City without requesting additional funds for contracted work. Any change orders to contracts resulted from new work agreements, such as for new permitting services or emergency coordination.

In addition to the engineering services CSE has completed for the City, CSE has also invested in the Isle of Palms beach academically. CSE has presented several papers and presentations about the shoal bypassing cycle, sediment transport, and engineering aspects of the Isle of Palms' beach in professional journals and scientific conferences around the world. In 2018, CSE sponsored five students from Delft University of Technology (Netherlands) to spend the summer at Isle of Palms studying the coastal processes and management as part of their graduate studies. They collected beach survey data and tide and current data, ran morphological models of sediment transport, and interviewed City staff and other members of the local community about beach management at Isle of Palms. The group developed a comprehensive report which received favorable reviews from their advisors at Delft.

CSE has been invested in the Isle of Palms for 40 years, and has gained valuable institutional knowledge while providing effective consulting services. We wish to continue this mutually beneficial relationship in the future.

Methodology

Section C – Methodology

This proposal is submitted at the request of the City of Isle of Palms (SC) for annual beach monitoring and post-project environmental monitoring services. The proposed services follow the completion of projects at either end of the island in 2006, 2017, and 2023, and include monitoring of those project areas as well as the remainder of the island.

This proposal covers five years of semi-annual beach condition surveys, including annual monitoring reports and mid-year summaries of survey data.

CSE was retained by the City to complete annual post-nourishment monitoring of the 2006 and 2017 project areas as well as the downcoast areas of Isle of Palms. Monitoring results have been submitted to the City, and provide updated beach condition assessments and analyses of shoreline change, including focused discussion of changes occurring at the dynamic east end. Annual monitoring of developed beaches is considered an essential aspect of coastal community management, and aids in damage prevention, recovery, and planning.

The present proposal covers the following engineering services required to provide five years of updated condition assessments for Isle of Palms' beach, similar to recent monitoring efforts. The most notable difference between this and previous proposals is the inclusion of proactive semi-annual monitoring of the entire island, as requested by the City.

Services Needed by the City of Isle of Palms:

- Semi-annual surveys of the oceanfront, including ~75 profile lines
- Semi-annual reports documenting beach volume changes and project performance
- Semi-annual oblique and ortho-rectified aerial image surveys

C.1. Planning, Communication, and Liaison

Project planning will include coordination and meetings with City representatives to:

- Review the final plan
- Develop schedules
- Participate in public forums
- Provide liaison with government agencies following annual surveys
- Assist the City with communication and liaison
- Coordinate with permitting agencies for compliance

Following authorization to proceed with the proposed scope of services:

1.1 CSE will communicate with City representative(s) to clearly define the goals and objectives for the work.

1.2 CSE will work with the City to schedule monitoring surveys at a time that will not impact public events, etc. CSE will coordinate with public safety officials regarding beach access and near-shore hydrographic work.

1.2 CSE will assist the City in preparing annual summaries, including display graphics for distribution to officials and the public through various mediums, including websites, newspapers, or City newsletters.

C.2. Semi-Annual Beach Condition Surveys

This project task will include semi-annual condition surveys of the beach and inshore zone [to approximately −15 foot (ft) depths]. These surveys will supplement previous field data by CSE and will be used for volume change analysis using reaches and boundaries similar to those in recent reports. The surveys can also satisfy the annual monitoring requirement of project permits should another project be completed within the agreement's timeframe, as the required monitoring area was established to match stations regularly monitored under the annual program.

CSE will also conduct semi-annual surveys of the beach between Dewees Inlet and Breach Inlet. The Engineer will reoccupy profile lines established under the prior monitoring agreement (~75 lines) and will obtain cross-sections from the foredune to approximately −15-ft depth contour, or at least 2,000 ft from the baseline.

Surveys will be conducted from April-May and August-September each year. These surveys will be completed using an RTK-GPS (Trimble™ Model R12i-GNSS) for topographic data collection. The offshore work will be performed using an Applanix Surfmaster POSMV INS positioning system linked to an Odom™ CV100 precision survey fathometer for direct measurements of the bottom without the need for tide corrections. Measurements over subaerial portions of Isle of Palms will extend to low-tide wading depth. Offshore profiles will be collected at 20 Hz but will be filtered in the office to eliminate spikes and provide a 5–7-point floating average. Smoothed offshore data will be edited to a manageable size and merged with subaerial data.

Field data will be entered into CSE's beach profile analysis system (BPAS) and combined with historical profile data. Each profile will be checked for proper juxtaposition with previous surveys. Changes between a survey and selected earlier surveys will be computed (similar to previous profile change analyses for the City by CSE). Overall volume changes by reach will be calculated by extrapolating unit-volume changes over representative shore lengths. CSE will evaluate the net direction and rate of sand transport to downcoast and upcoast reaches and identify developing erosion trends where applicable. Changes occurring within the project area will be identified, and CSE will discuss the project performance and condition of the closure dike and inlet.

C.3. Aerial Photography

Oblique aerial imagery will be collected semi-annually. Imagery will be used to offer visual depictions of the beach condition, dune condition, and shoal locations. Images will be placed side by side with historical images to offer easy-to-see comparisons of the present beach condition with historical conditions.

C.4. Semi-Annual Executive Summary and Annual Monitoring Report

Following the April-May survey, CSE will provide an executive summary to the City describing the shoreline condition. Once the August-September survey has been concluded, the results from both semi-annual assessments will be assembled into a comprehensive technical report, similar to monitoring reports provided to the City under previous monitoring contracts. Reports will document beach volume changes and dune condition and will identify potential concerns. Changes occurring in the project area will be described, and erosional hot spots will be identified. At the discretion of the City, CSE will present findings to City officials, the community, and/or resource agency officials at a schedule determined by the City (two presentations are assumed each year). [Note: CSE will also meet with the City's representatives at other times during each year around the time of field deployments and/or as other opportunities occur.]

C.5. Survey Capabilities

CSE will accomplish the proposed services by deploying one field crew to the Isle of Palms for approximately a one-week deployment. Coastal weather forecasts are monitored prior to deployment, allowing CSE to determine the most suitable wind, wave, and tide conditions for data collection. CSE will avoid collecting beach profiles immediately after storm events, as the beach shape may be altered from its typical configuration after storms. [Note: CSE will be available for emergency post-storm surveys if requested by the City of Isle of Palms as an additional scope of services.]

> CSE will be available to conduct emergency post-storm surveys as needed at the City's request.

At each profile, CSE will perform a topographic survey between the landward most accessible or at least 50 feet landward of the primary dune and low-tide wading depth (typically −6 ft NAVD or as far seaward as possible during low tide) using Trimble® R–12i Global Navigation Satellite System (GNSS) receivers utilizing the South Carolina Geodetic Survey (SCGS) South Carolina Real Time Network (SCRTN) for corrected positions. In areas where a connection to SCRTN is unavailable due to poor connectivity, a base station will be set up on a SCDHEC–OCRM monument for corrected positions broadcasted via UHF radio to the local area. Data in x-y-z format will be recorded at appropriate spacing along the transect to accurately depict the beach profile. The spacing between land data points will be no more than 10 ft and will include at a minimum all major breaks in slope. More data will be collected in the dunes, upper beach, and areas with a higher degree of varying topography. CSE prefers surveys performed on foot (with the GNSS antennae mounted on a survey rod) to those conducted on 4x4 vehicles due to errors associated

with varying loads in the vehicle and the potential for the vehicle to sink below the surface elevation of the sand. For this reason, a 4x4 utility vehicle will only be used to move the crew and instruments between stations. All transects will be surveyed using the Trimble® R–12i GNSS receiver mounted on fixed height 2-meter rod.

Offshore work will be performed the same week, typically within one or two days, as the onshore work and difference in time between the onshore and offshore data will never exceed three days. Offshore work is collected at high tide so that the vessel will overlap the land-based portion of the profile data. To maximize data collection, the inshore parts (1,500 ft from the most landward portion of the transect) of all profiles in a region may be collected during the high-tide window (±2 hrs from high tide) while the portions of the profile further offshore (1,500–6,000 ft from the most landward portion of the transect) may be collected on the same day during lower tides. Overwater data collection will be accomplished using HYPACK® 2024 software.

Bathymetric data will be collected at 20 Hz utilizing the Applanix™ POS–MV Surfmaster inertial navigation system and stored instantaneously on the vessel's dedicated high-performance computer. Soundings or depths will be measured by an Odom Echotrac CV100 single-channel echo sounder utilizing a 4° single beam transducer. Data will be collected from the vessel as far landward as possible at high tide. In CSE's experience, the overlap between the boat survey and land-based survey is between 50 and 100 ft, offering several comparison points between the two surveys. CSE generally removes the overlapping boat-based data to provide a smoother profile (errors in the boat-based survey data are compounded in the surf zone due to aeration, breaking waves, and distance from the track line. Therefore, the land-based data are assumed to be more accurate).

After all over-water work for a region is collected, data is examined in HYPACK® post-processing software. Spikes are removed, and the remaining data are smoothed using a 16-point filter in HYPACK® Single Beam Editor Software. Since offshore data are collected at 20 Hz, CSE generally reduces the number of data points to generate data files that are of manageable size. The land-based and overwater portions of each profile are then combined in Microsoft® Excel and examined to ensure the overlapping portions of the two surveys overlap and vertical differences between the two are minimal. Finally, the overlapping overwater data is removed to provide a complete profile.

C.6. Quality Assurance/Quality Control

From the analysis of tens of thousands of profiles over many years, CSE professionals have learned how to collect quality data efficiently, evaluate those data to identify processes affecting an area, and communicate the results to clients to provide sound solutions to beach management. Of the utmost importance is ensuring the accuracy of our data. CSE employs rigorous QA/QC procedures to ensure accurate data are being collected. As part of our ongoing attempt to offer the best

product, CSE utilizes the latest in surveying and communication technology. CSE is able to transmit data to office personnel, compare newly collected data with historical profiles, track weather, and communicate with the home office while mobilized in the field. This allows an efficient and effective means of ensuring data accuracy. QA/QC procedures for the land-based and overwater aspects of CSE's survey methods are detailed below.

Land-Based Survey

Prior to obtaining profile data, CSE's field team completes a QA/QC worksheet for both land (walking) and overwater work. Each sheet contains spaces for instrument configuration parameters and environmental conditions so that hardware setups, as well as project metadata (date, time, surveyors, weather conditions, and spatial references), are documented and checked. Most of the hardware configuration settings are digitally recorded with each data point; even so, having these QA/QC worksheets can eliminate errors that may arise from using different survey equipment, antennae heights, and instrument configurations at different locations. CSE regularly takes photos of profiles monitored as a way to make visual comparisons to prior years and for QA purposes.

Overwater Survey

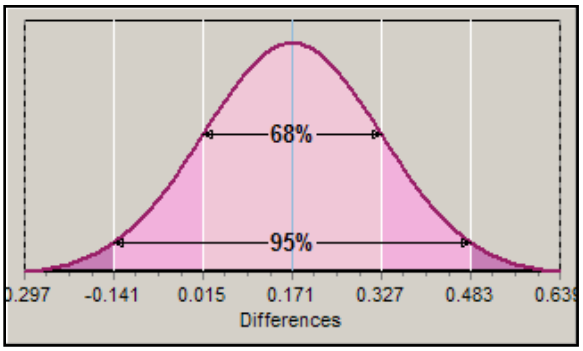
As with the land-based survey, field crews will complete a QA/QC form specific to overwater work prior to data collection from CSE's survey vessel. Instrument configurations are noted, including the positions of the GNSS antennas, the inertial motion unit (IMU) and echo sounder configuration, datum, units, dates, weather conditions, and software configuration settings. Fields for bar checks and speed of sound calculations are included in each worksheet.

Calibration of acoustic-sounding instruments is critical in assuring the accuracy of depth measurements. The speed of sound will be measured and recorded prior to, during, and after each survey day using a Castaway CTD instrument. Measurements are continuously recorded as the CTD is cast or lowered and retrieved through the entire water column to produce accurate conductivity, temperature, and depth profiles. From these observations, the CTD calculates a speed of sound vs depth profile which can be viewed immediately. The CTD also has a built-in GPS allowing each cast to be referenced to a specific time and location. Following the speed-of-sound calculation, the ODOM® CV100 sounder is calibrated to the average speed of sound, and a bar check is performed at 5-ft intervals. A bar check is one of the oldest methods for calibrating an echo sounder. A bar is lowered at fixed, known depths below the transducer and the sounder depth is checked at each depth, and any adjustment is made to provide a consistent and accurate measure. Bar checks will be repeated once during surveying, and after surveying each day. Results of the speed of sound calculation and bar checks will be recorded on daily QA/QC forms.

With RTK-GNSS and SCRTN capability, CSE can reduce error and field time during offshore work. RTK– GNSS eliminates the need for tidal corrections, which can introduce error and complicate processing, and SCRTN eliminates the need to set up base stations, meaning the crew can spend more time surveying while achieving centimeter accuracy.

HYPACK® software is used to produce planned line files and offers the ability to automatically eliminate data that does not meet precision thresholds (HDOP, PDOP, RTK, Fix, etc). It also provides alarms to let the boat operator know when the boat has deviated a set distance away from the survey line. CSE will set the limit to 20 ft as prescribed in the RFP. The position and orientation of the boat relative to the survey line are updated in real time, allowing CSE to obtain straight profiles. Data from the land-based survey are entered into HYPACK® before overwater work to ensure the boat overlaps the land-based data.

CSE will establish shore-parallel survey lines that intersect the beach profile lines to provide crossing statistics using HYPACK® software. This offers a description of the average differences in measured elevation at points in the survey area. At each intersection between the shore-parallel line and the profile lines, HYPACK® computes the difference in elevation. Statistics are calculated showing the average elevation difference (total and absolute value) for all crossings. Since the shore-parallel lines and beach profile lines are likely to be collected at different tidal stages, a low mean difference and standard deviation ensure that instruments were configured properly. On the right, an example output from the HYPACK® crossing statistic is shown which represents data collected over three days at all stages of the tide.



Cross Statistics Report

Number Of Intersections	300
Search Radius (ft)	25
Standard Deviation (ft)	0.156
Absolute Difference Mean (ft)	0.171
Arithmetic Mean (ft)	-0.033

Accuracy

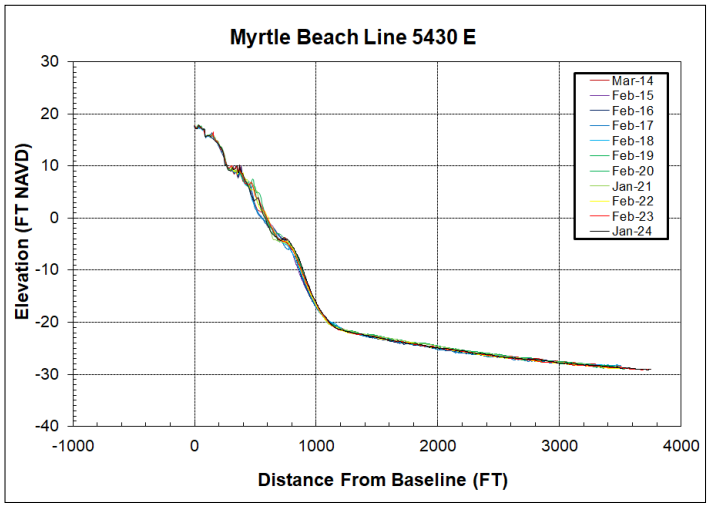
CSE utilizes the latest in surveying technology to obtain accurate beach profiles. The accuracy of beach profiles is limited by the resolution(s) of the instrument(s) being used. With RTK-GNSS coupled with SCRTN virtual reference system (VRS) technology, overland portions of the profile can easily achieve a horizontal and vertical accuracy of <5 cm. CSE typically sets its accuracy limits at 0.04 ft (~1.2 cm) for horizontal and 0.06 ft (~1.8 cm) for vertical when collecting land-based data (meaning a topographic point will not be taken when this threshold is exceeded). CSE uses a Trimble® R–12i GNSS mounted to a survey rod. This accuracy is obtained from the dunes (monument) to low-tide wading depth (typically −6 ft NAVD).

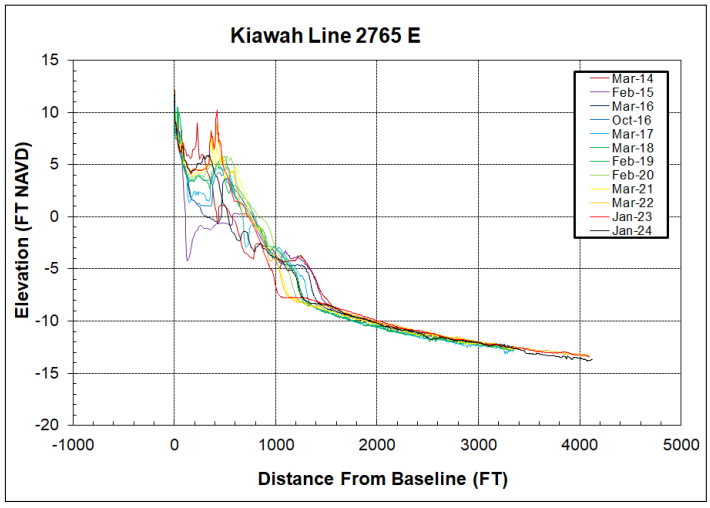
The overwater portion of the survey is necessarily less accurate due to the additional instrumentation and methods associated with data collection. The RTK–GNSS maintains the <2 cm accuracy; however, additional error is associated with the sounder (0.01 m ± 0.1% depth, with a 0.1-ft resolution), and with the motion/location of the survey vessel. The location of the survey vessel with respect to the survey line may also introduce error in the profile (overlaps with the land-based data may be a horizontal distance of up to 20 ft from the "survey line").

CSE collects offshore data beginning at the seaward end of the profile and proceeds towards the beach. This offers a "smoother" profile, as the boat motion is in the same direction as waves. It

also ensures that the nearshore portion of the profile is collected close to the intended line, as the boat does not have to turn and immediately begin collecting data. This offers better overlaps with the land-based survey. A factor contributing to CSE's quality data collection is the vessel used. CSE's shallow draft survey boat provides a fully-enclosed cabin with high visibility and good protection for the electronics that are the heart of the instrumentation. Full-size computer monitors are used to aid navigation along planned lines and provide real-time images of the profile as it is collected. The survey vessel is more stable than jet-skis or semi-inflatable vessels used for similar surveys. This reduces crew fatigue and allows for longer data collection periods.

The graphic on the right shows profiles from two locations where CSE collected profiles for the OCRM BERM project from 2014 to 2024. The upper profile is from Myrtle Beach (SC) at beach profile monument 5430E. The lower profile is from Kiawah Island (SC) at beach profile monument 2765E. Note how the seaward portions of the Myrtle Beach profile show good overlap between the CSE surveys. Overlap in the profile beyond the depth of closure indicates the methods used by CSE produce accurate profiles. The Kiawah profile is from the east end of the island and demonstrates an erosional beach due to the increased tropical cyclone activity in recent years.





C.7. Equipment and Software

CSE's equipment and software are discussed below. In the event of equipment malfunction, CSE maintains strong relationships with equipment suppliers and will replace or rent needed equipment promptly (often overnight) to continue data collection.

The R/V Southern ECHO

The 24-ft Tuff Boat, R/V Southern ECHO, is a custom welded aluminum-hull boat, powered by twin Suzuki 115 HP outboard motors. An extremely shallow draft and fully enclosed pilothouse allow CSE's licensed captain and crew to collect bathymetric data close to shore and under a wide range of conditions. The R/V Southern ECHO can operate in water depths as shallow as 1.5 ft, which allows for continuous data collection into the surf zone.

Trimble® R12i GNSS Receiver with SCRTN VRS (2 units)

The Trimble® R12i GNSS receiver is utilized to collect topographic data. The unit is capable of ~10 millimeter (mm) horizontal accuracy and ~20 mm vertical accuracy. Integrated cellular network connectivity to the SCRTN VRS eliminates the need for a separate 'base station.' Using the SCRTN VRS decreases setup time, personnel requirements, equipment costs, and error sources.

Applanix™ POS MV Surfmaster

The R/V Southern ECHO is equipped with a fully dedicated Global Navigation Satellite System (GNSS) and integrated inertial motion unit (IMU) to produce a full six-degrees-of-freedom position and orientation solution. The POS MV Surfmaster provides accurate attitude, heading, heave, position, and velocity data of the vessel and onboard sensors.

Odom EchoTrac CV100 and SMSW200-4a Transducer

CSE uses a single-frequency Odom Echo Sounder (EchoTrac CV100) for depth measurements. The sounder has a depth range of 0.8 ft to 1,000 ft. The stainless steel transducer has a 4° beam width and is designed to operate in very shallow depths. The unit has a resolution of 0.1 ft and an accuracy of 0.01 m (0.03 ft) ± 0.1% of depth.

The CastAway®-CTD

The CTD is a lightweight, easy-to-use instrument capable of simultaneous measurements of conductivity (salinity), temperature, depth, pressure, salinity, and density. CSE utilizes the CTD to calculate and record the speed of sound vs. depth profile. The speed of sound results are used to calibrate the Odom sounder.

Polaris Ranger UTV

The Polaris Ranger is a "side-by-side" utility vehicle (UTV). The four-wheel-drive UTV is utilized to safely and efficiently transport personnel and equipment between survey transects.

C.8. Software

CSE maintains up-to-date software licensing and support for the following software, which will be used in the proposed work and analysis.

HYPACK® 2024 (Overwater Work)

Provides tools to design surveys, collect data, apply corrections to soundings, remove outliers, plot field sheets, export data to CAD, compute volume quantities, generate contours, create side-scan mosaics, and create/modify electronic charts (www.hypack.com). HYPACK® provides graphical editing and sounding selection routines that allow for quick preparation of survey data for plotting, export to CAD, or several other final products. The SINGLE BEAM EDITOR of HYPACK® provides for:

- Graphical review and editing of track lines and depth profiles
- Display of design templates and previous survey profiles
- Real-time telemetry gauges
- RTK tides
- Sound velocity corrections

Trimble® Business Center (Overland Work)

Trimble® Business Center™ (TBC) software is the ideal software for integrating real-time kinematic (RTK), post-processed GNSS, and conventional survey data. Designed for ease of use, high productivity, and quality control, the software imports, checks, and processes field data. The data is stored in Microsoft Access database format for easy customized access, reporting, and editing. The Trimble® Business Center™ software provides a seamless link between field collected data and third-party design, CAD, and GIS packages. Data can be exported to a wide variety of standard data formats.

MATLAB®

MATLAB® is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. Using the MATLAB® product, you can solve technical computing problems faster than with traditional programming languages, such as C, C++, and Fortran (www.mathworks.com). CSE uses MATLAB® to quickly plot and export data into a variety of formats. CSE has produced custom MATLAB® scripts for plotting and analysis of beach profile data in a variety of formats.

Microsoft Office®

CSE utilizes Microsoft® Office, and can provide the City of Isle of Palms with data as such as Excel (.xls or .xlsx) or Access (.dbf) in either version's format.

AUTOCAD Civil 3D, ESRI ArcMap, and Global Mapper

CSE uses these software packages for GIS applications including data archiving, QA/QC, drawings, graphics, and database management. These software programs allow CSE to provide clients data in several formats, including .shp, .kmz, .csv, .dwg, .dwf, .mxd, and several other formats.

C.9. Project Schedule

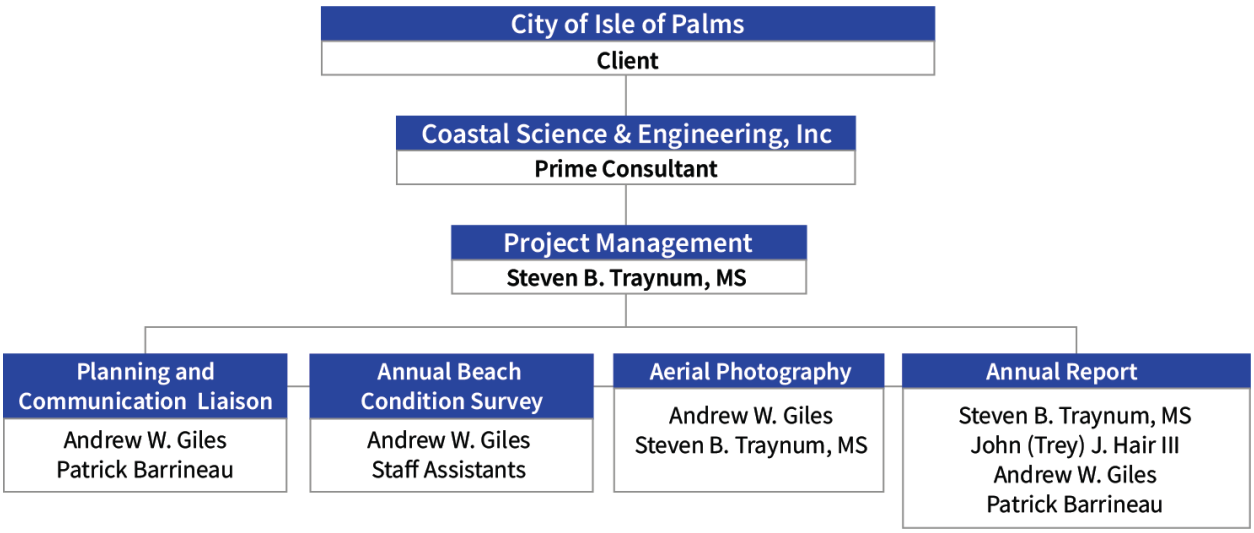
The schedule is based on a start date of August 2024 for the services proposed herein. The schedule may be modified at the direction of the City. An anticipated schedule is provided below. The schedule is subject to change at the request of the City.

Date	Task#	Description
Aug 2024	1	Initiate work under the present proposal/finalize plan with the City
Aug-Sep 2024	2, 3	First Year 1 Condition Survey and Aerial Imagery
Nov 2024	4	Year 1 Executive Summary
April-May 2025	2, 3	Second Year 1 Condition Survey and Aerial Imagery
July 2025	4	Year 1 Comprehensive Report – End of Year 1 Services
Aug-Sep 2025	2, 3	First Year 2 Condition Survey and Aerial Imagery
Nov 2025	4	Year 2 Executive Summary
April-May 2026	2, 3	Second Year 2 Condition Survey and Aerial Imagery
July 2026	4	Year 2 Comprehensive Report – End of Year 2 Services
Aug 2026	2, 3	First Year 3 Condition Survey and Aerial Imagery
Nov 2026	4	Year 3 Executive Summary
April-May 2027	2, 3	Second Year 3 Condition Survey and Aerial Imagery
July 2027	4	Year 3 Comprehensive Report – End of Year 3 Services
Aug 2027	2, 3	First Year 4 Condition Survey and Aerial Imagery
Nov 2027	4	Year 4 Executive Summary
April-May 2028	2, 3	Second Year 4 Condition Survey and Aerial Imagery
July 2028	4	Year 4 Comprehensive Report – End of Year 4 Services
Aug 2028	2, 3	First Year 5 Condition Survey and Aerial Imagery
Nov 2028	4	Year 5 Executive Summary
April-May 2029	2, 3	Second Year 5 Condition Survey and Aerial Imagery
July 2029	4	Year 5 Comprehensive Report – End of Year 5 Services

Project Team

Section D – Project Team

CSE's proposed team members bring a combined 80 years of experience in beach erosion studies and surveys. This experience is reflected in projects completed and professional publications related to beach survey and analysis techniques. CSE's staff is intimately familiar with the area based on prior experience along South Carolina's coast mapping shorelines, designing beach nourishment projects, and performing monitoring for a number of communities. The proposed organization chart below lists the personnel and project organization that CSE proposes to complete the work.



Steven Traynum – Project Management

Mr. Traynum has 17 years of experience specializing in coastal hydrodynamics and estuarine processes. He also serves as project manager for several local beach monitoring programs and beach nourishment projects for CSE (ie – Kiawah, Seabrook, Edisto, Hunting Island, Isle of Palms). His coastal engineering project experience includes monitoring and analyzing erosion and morphological changes of natural and nourished beaches and coastal inlets, measuring and analyzing tidal inlet currents, and land and hydrographic surveys, including sediment collection on land and in deep water. Mr. Traynum has collected hundreds of beach profiles using the latest surveying techniques (RTK-GNSS). He serves as project manager for local beach monitoring programs involving the collection and analysis of land-based and hydrographic profile data to determine short and long-term erosion rates, as well as underlying causes of erosion. Relevant work experience includes:

SCDHEC-OCRM – Project Manager. Collection of Beach Erosion Monitoring Data along ~400 profiles. Conducted in-office Quality Assurance / Quality Control (QA/QC), generated direct deliverables for SCDHEC-OCRM staff and management.

Edisto Beach (SC) – Project Manager. Post-project beach monitoring encompassing ~90 survey stations, including three stations per groin cell. Participated in field data collection and analysis. Generated monitoring reports showing comparative conditions of the beach.

Andrew Giles – USCG licensed Near Coastal Master – Field Data Collection

Captain Andrew Giles is the senior technical associate specializing in bathymetric and topographic field data collection and data management for CSE (2006-present). Mr. Giles holds a BS from the University of South Carolina. He is a Coast Guard-licensed Master of 50 GT Near Coastal (License #2876702), has Hypack® Certification (2017), and is a licensed FAA UAS pilot (Certificate #3971935). His field data collection experience includes topographic and bathymetric surveys via the latest methods of Real-Time-Kinematics positioning (RTK-GNSS) utilizing Virtual Reference Station (VRS) and Real Time Networks (RTN) for achieving centimeter-level accuracy. Captain Giles has conducted these surveys in a wide range of tidal and wave energy conditions and has field experience at almost every beach and inlet in South Carolina.

SCDHEC-OCRM – Project Manager and Field Party Leader (data collection) for the collection of beach erosion monitoring data along ~400 profiles (~3,500 ft long) during all deployments throughout 2013–2024 surveys.

Isle of Palms (SC) – Field Party Leader (data collection). Collected data along ~130 beach and inshore profiles along the Isle of Palms beach. The scope of services included a bathymetric survey of Dewees Inlet and Breach Inlet (lines spaced between 200 and 800 ft over ~8 sq. miles) and the development of a three-dimensional digital terrain model from 2013 to 2023. These data provide a decade-long time series illustrating complex shoal migration and cycling over an ebb-tidal delta – the first comprehensive dataset of its kind along the East Coast.

Patrick Barrineau, Ph.D., PG – Planning and Communication Liaison

Dr. Barrineau is a coastal scientist and project manager, providing exceptional sedimentary processes and landscape evolution expertise. He manages projects in New York, North Carolina, South Carolina, and Georgia, and regularly curates geophysical data from field collection to publication in concert with CSE staff. Dr. Barrineau has prepared reports and permit documents for projects at Bridgehampton-Sagaponack (NY), Nags Head (NC), Cape Hatteras National Seashore (NC), Avon (NC), Buxton (NC), Arcadian Shores (SC), Myrtle Beach (SC), Pawleys Island (SC), Debidue Island (SC), Kiawah Island (SC), Seabrook Island (SC), Edisto Beach (SC), and Sea Island (GA). Dr. Barrineau served as the principal sub-consultant to VHB (Vanasse Hangen Brustlin, Inc) for the National Park Service Programmatic EIS for beach nourishment events in Cape Hatteras National Seashore, which provides guidance for 30+ years of anticipated beach restoration projects in the Northern Outer Banks.

Dare County (NC) – Project Manager. Primary liaison between Dare County, NPS, USACE, and the State of North Carolina. Design of nourishment plan and construction management, followed by post-project beach monitoring. Participates in field data collection and analysis. Generates monitoring reports showing comparative conditions of the beach.

Myrtle Beach (SC) – Project Manager. Responsible for data collection, analysis, and preparation of annual monitoring reports for the City of Myrtle Beach following federal nourishments along ~ 9 miles of oceanfront.

Trey Hair – Senior CAD Engineering Technician – Mapping, GIS, and Reporting

Mr. Hair is an engineering technician with 25 years of experience supporting CSE's professional engineers and geologists in projects pertaining to beach nourishment, groin and jetty design, revetments and seawalls, and inlet relocations. He performs profile analysis from collected and/or existing data, historical shoreline mapping, topographic and bathymetric data compilation, and volume change calculations. Mr. Hair maintains CSE's annual monitoring project database, including data from locations in South Carolina, North Carolina, and other East Coast beaches. He has extensive data collection experience, including field investigations of project sites, installation of coastal engineering instrumentation, and sediment sample collection. Mr. Hair is proficient in survey processes from the initial setup of projects to data reduction and map production. Relevant project experience includes:

Bogue Banks (NC) – Engineering Technician. Collection and analysis of beach profiles from ~160 stations along nearly 35 miles of shoreline (including adjacent islands). He produced construction plans that included profile data and nourishment fill quantities.

Edisto Beach and Hunting Island (SC) – Engineering Technician. Assembled beach profile data and nourishment fill templates for permit drawings and construction plans. He also assisted with beach profile data collection and analysis.

Isle of Palms (SC) – Engineering Technician. 3D modeling of the beach and offshore zone, including inlet shoals. He assisted in the development of monitoring baselines and the collection and analysis of beach profile data.

Budget

Section E –Budget

The fee for CSE services will be based on the charges listed below. All fee quotations are estimates, and actual fees are based on actual time and expenses incurred by CSE unless otherwise stated in the proposal. All rates are listed in U.S. dollars.

Fees by task are based on estimated numbers of person-days to accomplish the scope of services detailed herein. In-office expenses include communication, copying, insurance (etc) and are charged as a percentage of fees rather than separate itemization. Direct expenses include travel (standard U.S. government mileage rate), lodging and per diem, 4-by-4 beach vehicle rental at $120/day, survey boat rental at $600/day, RTK-GPS rental at $500/day, fuel and dockage at cost, sediment testing at $60/sample, and field supplies at cost.

PERSONNEL	Staff Category	Hourly Rate
	Principal	195.00
	Coastal Engineer/Project Manager	175.00
	Sr Technical Associate/Coastal Scientist	150.00
	Technical Staff (CAD)	125.00
	Tech-Field Assistants	100.00

Task #	Task Description	Task Fee
1	Planning, Communication, Liaison	$13,560
2	Semi-Annual Beach Condition Survey (per year)	$37,160
3	Semi-Annual Aerial Photography (per year)	$7,200
4	Semi-Annual Report (per year)	$29,960
1–4	Labor Subtotal - Tasks 1–4	$87,880
	In Office Expenses - Tasks 1–4	$4,394
	Direct Expenses - Tasks 1–4	$13,726
	Total Project Tasks 1–4 (annual)	**$106,000**
	Cost of Annual Services for All Five Years	***$530,000***

Additional Services

The work described in the scope of services (paragraphs C1.1 through C4.2) does not include work in the following categories. Work in these categories or other services requested by the City will be considered additional services.

If the City wishes CSE to perform any of the following additional services, the City shall so instruct CSE in writing and the Engineer will perform or obtain from others such services and will be paid as provided in the Agreement for Professional Services between the City and the Engineer.

- Services resulting from significant changes in the general scope, extent or character of the project, or major changes in the documentation previously accepted by the City where changes are due to causes beyond CSE's control
- Providing renderings or models outside of what is presented in Tasks 1–4
- Detailed consideration of operations, maintenance and overhead expenses; value engineering; and the preparation of rate schedules, earnings and expense statements, cash flow and economic evaluations, feasibility studies, appraisals and valuations
- Furnishing the services of environmental scientists, biologists, fisheries scientists, chemical analysis laboratories or other specialized scientific testing, evaluations or services not specifically included in the scope of services
- Geotechnical engineering studies, including sediment sampling, borings, and reports not specifically included in the scope of services
- Preparing to serve or serving as a consultant or witness in any litigation, arbitration, or other legal or administrative proceeding except where required by the scope of services
- Services of the independent cost estimator shall be additional services

Add-On Services

In the event the City requires any additional surveys for pre-/post-storm assessments or other reasons, CSE will complete a comprehensive survey of the island using the same scope and methods as outlined in Task. Fees and expenses for additional surveys will be the same as Task 2 costs shown above. A brief letter report will be prepared that will summarize volume changes from the previous survey.

References

References

Section F – Client References

CSE offers the following examples of recent projects and encourages the City to contact the persons listed below to discuss our work.

DeBordieu Colony Community Association		Town of Pawleys Island	
Owner Contact	Blanche Brown General Manager	**Owner Contact**	Daniel Newquist Town Administrator
Telephone	843–527–4436	**Telephone**	843–237–1698
Email Address	bbrown@debordieucolony.org	**Email Address**	dnewquist@townofpi.com
Services Provided	Engineering services for beach nourishment and groin construction (2022) and beach profile monitoring	**Services Provided**	Engineering services for a 2020 beach nourishment project and beach profile monitoring
Litchfield Beach		**Seabrook Island POA**	
Owner Contact	Konni McMurray Peninsula Property Owners Assoc.	**Owner Contact**	Steve Hirsch, PE, PMP Director of Engineering
Telephone	910–690–1314	**Telephone**	843–768–0061
Email Address	kmcmurray422@gmail.com	**Email Address**	shirsch@sipoa.org
Services Provided	Engineering services for a 2022 nourishment project along Inlet Point and ongoing beach monitoring	**Services Provided**	Engineering services for the 2015 relocation of Captain Sam's Inlet and beach monitoring
Town of Edisto Beach		**Dare County, North Carolina**	
Owner Contact	Mark Aakhus Town Manager	**Owner Contact**	Robert Outten County Manager/Attorney
Telephone	843–869–2505	**Telephone**	252–475–5811
	maakhus@townofedistobeach.com	**Email Address**	outten@darenc.com
Services Provided	Engineering services for the Edisto Beach nourishment project (2017), groin maintenance, and ongoing beach profile monitoring, FEMA coordination	**Services Provided**	Engineering services for beach nourishment: Village of Buxton (2018 & 2022), Avon Village (2022), and ongoing engineering and beach monitoring services
Hunting Island, South Carolina		**City of Folly Beach**	
Owner Contact	Nicholas Leitner Chief of Engineering	**Owner Contact**	Tim Goodwin Mayor
Telephone	803–734–0258	**Telephone**	843-729-0298
Email Address	nleitner@SCPRT.com	**Email Address**	tgoodwin@cityoffollybeach.com
Services Provided	Engineering services for the 2006 and 2020 Hunting Island State Park beach nourishment and groin construction project and ongoing beach profile monitoring	**Services Provided**	Profile monitoring, USACE project coordination, community outreach, resilience planning

Bid Forms

Oath of Non-Collusion
Pending Legal Actions

Sections G-H – Required Bid Forms and Information

Included are the following required forms and information:

- Section G — Oath of Non-Collusion (included on the following page)

- Section H — Statement Regarding Pending Legal Actions

    - **Pawleys Island, SC**
      CSE was named a party in a suit along with other entities regarding the possible impacts of a beach nourishment project on adjacent shorelines. CSE is working with all parties to mediate the case in a manner that is acceptable to all.

NON-COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he/she has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He/She further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee gift, commission or thing of value on account of such sale.

OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated this 7th day of August, 2024

Coastal Science & Engineering, Inc
(Name of Organization)

President
(Title of Person Signing)

(Signature)

ACKNOWLEDGEMENT

STATE OF South Carolina)
) ss
COUNTY OF Lexington)

CARRIE A. MARKS NOTARY PUBLIC EXP. July 21, 2033 SOUTH CAROLINA

Before me, a Notary Public, personally appeared the above named and swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to me this 7th day of August, 2024.

Carrie A Marks
Notary Public Signature

My Commission Expires: July 21, 2033

Appendices

Staff Resumes

Equipment

APPENDIX A

Staff Resumes

STEVEN B TRAYNUM

COASTAL PHYSICAL SCIENTIST

Email: straynum@coastalscience.com

PROFILE

Mr. Traynum specializes in coastal hydrodynamics and estuarine processes (2007–present). He also serves as project manager for numerous beach monitoring programs and nourishment projects. Mr. Traynum is experienced in critical area permitting including analysis of environmental impacts and preparing biological assessments and EIS documents. Liaises between resource agencies and clients, and assists in developing appropriate monitoring plans to determine project impacts to endangered and threatened species. His coastal engineering project experience includes design of coastal erosion mitigation projects, monitoring and analysis of erosion and morphological changes of natural and nourished beaches and coastal inlets, measurement and analysis of tidal inlet currents, and on-site land and hydrographic surveys.

TECHNICAL EXPERIENCE

Extensive experience in estuarine and coastal settings including deployment and recovery of hydrographic equipment, such as acoustic Doppler current profilers (SonTek, RDI, Nortek), acoustic Doppler velocimeters, CTDs, and pressure sensors.

Mr. Traynum has collected thousands of beach profiles using the latest surveying techniques (RTKGPS). He is a certified (SSI), open-water diver.

COASTAL EROSION/RENOURISHMENT EXPERIENCE

Managed restoration projects at Nags Head (NC) involving placement of 4.6 million cubic yards (cy) of sand, Isle of Palms (SC) involving placement of 2.5 million cy, Folly Beach (SC) involving placement of 415,000 cy and 745-ft-long terminal groin construction, and Edisto Beach (SC) including placement of one million cy and construction management for 25 groin extensions (~$5 million).

Project manager for beach monitoring programs involving collection and analysis of land-based and hydrographic profile data to determine short- and long-term erosion rates and project performance and impacts. Monitoring sites include: Isle of Palms, SC Hunting Island, SC Edisto Beach, SC Kiawah Island, SC

Critical area permitting for projects in SC and NC, including Biological Assessments, Essential Fish Habitat reports, EIS documents, and monitoring programs coordinated with USFWS, USACE, NMFS, and state agencies.

MatLab® scripts for automatic generation of sediment grain-size distributions, beach profile analysis, and nourishment profile design.

EDUCATION

MS. Marine Science, University of South Carolina
BS. Marine Science, USC Honors College
Coastal Engineering Certificate, Old Dominion University
ME. Coastal Engineering (pending) Old Dominion University

SPECIALTIES

- Beach nourishment design and monitoring
- Design of coastal structures
- Environmental impact assessments
- Coastal and estuarine processes
- Collection and analysis of beach profile data
- Hydrographic instrument deployment
- Collection and analysis of coastal sediments

SOFTWARE PROGRAM CAPABILITIES

- ArcGIS
- Global Mapper
- MatLab
- Microsoft Office

SELECT PUBLICATIONS

Traynum, SB, TW Kana, HL Kaczkowski. 2019. The construction and impacts of a groin-lengthening project at a southeast U.S. beach. In Proc. Coastal Structures 2019 (Hanover Germany) 30 Sep – 20 Oct, 10 pp.

Traynum, SB, TW Kana, and DR Simms. 2010. Construction and performance of six template groins at Hunting Island, South Carolina. Shore & Beach, Vol 78(3), pp 21–32.

Kana, TW, HL Kaczkowski, and SB Traynum. 2015. (BC) An empirical approach to beach nourishment formulation. Chapter 4 in YC Kim (ed), *Design of Coastal Structures and Sea Defenses*, Vol 2, Series on Coastal and Engineering Practice, World Scientific, pp 105–144.

Kaczkowski, HL, SB Traynum, TW Kana, and M Rentz. (2015) Terminal groin and beach restoration at Folly Beach County Park (South Carolina). In D Cox and L Wallendorf (eds), Proc. Coastal Structures and Solutions to Coastal Disasters, ASCE– COPRI (Boston MA, 9–11 September 2015), 12 pp.

Kana, TW, SB Traynum, D Gaudiano, HL Kaczkowski, and T Hair. 2013. The physical condition of South Carolina beaches 1980–2010. Jour Coastal Research, Special Issue 69, pp 61–82.

ANDREW W GILES III

SENIOR TECHNICAL ASSOCIATE

Email: dgiles@coastalscience.com

PROFILE

Captain Andrew Giles is CSE's Senior Technical Associate overseeing field operations and specializing in bathymetric and topographic field data collection and data management (2006–present). Mr. Giles holds a BS from the University of South Carolina. He is a Coast Guard licensed Master, FAA licensed UAS pilot, and has HYPACK® Certification (2017). His experience includes leading, planning, and coordinating topographic and bathymetric surveys using the latest methods of Real Time Kinematics positioning and navigation (RTK-GNSS) utilizing Real Time Networks (RTN) and Unmanned Aerial Systems (UAS) for aerial mapping operations.

PROFESSIONAL CERTIFICATIONS

USCG Licensed Captain – 50 GRT Master #2876702
FAA Licensed UAS Pilot – Remote Pilot #3971935
SSI–Certified Open Water Diver
AHA CPR/First Aid Certified

SOFTWARE PROGRAM CAPABILITIES

HYPACK®
Trimble® Business Center
Global Mapper®
Pix4D

TECHNICAL EXPERIENCE

Captain Giles leads, supervises, and coordinates all CSE field data collection operations (2013–present). Gile served as field survey assistant under the tutelage of Captain Philip McKee (2006–2012).

Giles has experience operating research vessels engaged in bathymetric data collection as data technician and as coxswain (2006–present).

Giles specializes in topographic and bathymetric data collection using RTK-GNSS, specifically using the Applanix™ POS-MV and Trimble® R10 GNSS receiver. Giles has collected thousands of beach profiles for the purpose of erosion and sediment transport monitoring. He also specializes in UAS data collection for aerial mapping (2015–present).

He has been highly involved in dive operations at CSE including deployment, recovery, and operation of in-situ flow meters, tide gauges, wave gauges, and acoustic Doppler current profilers (ADCP).

Giles has also assisted in the collection of hundreds of borings in offshore borrow sites for beach nourishment planning.

EDUCATION

BS. University of South Carolina

BATHYMETRIC & TOPOGRAPHIC DATA COLLECTION EXPERIENCE LOCATIONS

Arcadian Shores, SC
Bay Point, SC
Bear Inlet, NC
Bear Island, NC
Bogue Banks, NC
Breach Inlet, SC
Buxton, NC
Cape Hatteras National Seashore, NC
Captain Sams Inlet, SC
Daufuskie Island, SC
DeBordieu, SC
Dewees Island, SC
Edisto Beach, SC
Folly Beach, SC
Fripp Island, SC
Garden City Beach, SC
Harbor Island, SC
Hilton Head Island, SC
Hunting Island, SC
Huntington Beach State Park, SC
Isle of Palms, SC
Jumby Bay Island, Antigua
Kiawah Island, SC
Kiawah River, SC
Litchfield Beach, SC
Lockwoods Folly Inlet, NC
Moriches Inlet, NY
Myrtle Beach, SC
Nags Head, NC
North Myrtle Beach, SC
Oak Island, NC
Oregon Inlet, NC
Pawley's Island, SC
Port of Moorehead City, NC
Rodanthe, NC
Sea Island, GA
Seabrook, SC
Shackleford Banks, NC
Smith Point, NY
Southampton, NY
Sullivans Island, SC
Surfside Beach, SC
Waties Island, SC

C PATRICK BARRINEAU, PHD PG

COASTAL SCIENTIST

Email: patrick@coastalscience.com

PROFILE

Dr. Barrineau is a coastal scientist and project manager for CSE, performing work in the field, laboratory, and office. He manages projects from New York to Georgia, and regularly curates geophysical and geotechnical data from collection to publication in concert with CSE staff.

While at CSE, Dr. Barrineau has prepared reports and/or permit applications for projects at dozens of sites from New York to Georgia. Prior to joining CSE, Dr. Barrineau studied sedimentary processes and quaternary geology at Texas A&M through field-based research on sediment transport and barrier-lagoon evolution. He has organized and led field studies in South Carolina, Texas, New Mexico, California, and Brazil. In addition to his work at CSE, Dr. Barrineau teaches a graduate-level course in Coastal Zone Management at the University of South Carolina.

EDUCATION

PhD. Geography, Texas A&M University
MS. Geography, University of South Carolina
BS. Geography, Auburn University

REGISTRATION

Professional Geologist (SC #2773, NC #2761)

RESEARCH EXPERIENCE

Conceptual and numerical modeling of landscape evolution in coastal and aeolian systems; modeling fluid dynamics and sediment transport; identifying controls on sediment transport patterns; monitoring beach and dune response and recovery following storm impacts; managing geophysical surveys for Quaternary landscape evolution studies. Extensive field research in environments from the Pacific Rim to the Caribbean to the Middle East.

TECHNICAL EXPERIENCE

Extensive experience working in coastal and dryland settings, collecting elevation and geophysical data using RTK-GPS, Total Station, ground-penetrating RADAR, and Electromagnetic Induction Profilers. Collected vibracores and analyzed hundreds of sediment samples for grain size, sorting, and X-ray fluorescence analysis.

SPECIALTIES

- Synthesizing interdisciplinary research into adaptive management strategies
- Collection & analysis of spatial & geophysical data
- Collection & analysis of coastal sediments
- Beach & Dune processes
- Quaternary landscape evolution

SOFTWARE PROGRAM CAPABILITIES

- GIS - ArcGIS, QGIS, Global Mapper
- Remote Sensing - ERDAS Imagine, ENVI
- Coding Languages – MATLAB, Python, R

SELECT PUBLICATIONS

Barrineau, P., Kana, T., 2023. Beach nourishment and sediment management plan for Sagaponack and Bridgehampton at Southampton, New York. *Coastal Sediments*, vol. 10, New Orleans LA.

Elko, N., Briggs, T., Marsooli, R., Barrineau, P., Hapke, C., McKenna, K., Simm, J., Beyeler, M., Smith, M., Troy, C., 2022. U.S. community perspectives on coastal flooding. *Shore and Beach* 90(3), 17-29.

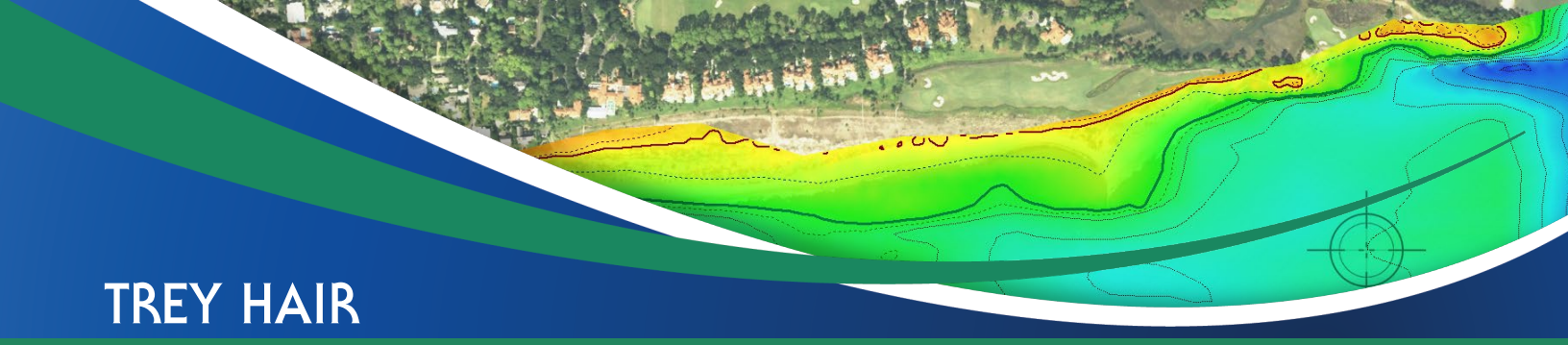
Barrineau, P., Janmaat, R., Kana, T., 2021. Empirical depths of closure along the US East Coast. *Coastal Engineering* 170 DOI 10.1016/j.coastaleng.2021.104009.

Harris, M., Ellis, J., Barrineau, P., 2020. Evaluating the geomorphic response from sand fences on dunes impacted by hurricanes. *Ocean and Coastal Management* 193 DOI 10.1016/j.ocecoaman.2020.105247.

Barrineau, P., Kana, T., 2019. Unpacking Storm Damages on a Developed Shoreline: Relating Dune Erosion and Urban Runoff. *Shore and Beach* 87(3), 35-45.

Houser, C., Barrineau, P., Hammond, B., Saari, B., Rentschler, E., Trimble, S., Wernette, P., Young, S., 2017. Role of the foredune in controlling barrier island response to sea level rise. In: *Barrier Islands*, ed. Moore and Murray.

Barrineau, P., Wernette, P., Weymer, B., Trimble, S., Hammond, B., Houser, C., 2015. Coastal Landscapes in the Critical Zone. In: *Principles and Dynamics of the Critical Zone*, Vol. 19, pp. 495-420.



TREY HAIR

ENGINEERING TECHNICIAN

Email: thair@coastalscience.com

PROFILE

Mr. Hair is an engineering technician with 20 years of experience who supports CSE's professional engineers and geologists in projects pertaining to beach nourishment, groin and jetty design, revetments and seawalls, inlet relocations, as well as waterfront and marina designs. He performs profile analysis from collected and/or existing data, historical shoreline assessments, topographic and bathymetric data compilation, volume calculations, erosion assessments, and sediment transport studies.

As CSE's CAD manager, Mr. Hair utilizes numerous data-based, land-development software programs in the design of coastal engineering projects including beach nourishment, groins, jetties, seawalls, and inlet relocations. He maintains CSE's database of beach monitoring projects in numerous southeastern locations including South Carolina sites (Seabrook Island, Folly Beach, Kiawah Island, Myrtle Beach, Hunting Island, Edisto Island, Isle of Palms) and North Carolina sites (Bogue Banks, Ocean Isle Beach, Nags Head, Kitty Hawk, Buxton, Hatteras Is). He uses ArcMap GIS software to assess shoreline changes, to support FEMA flood studies, to conduct spatial analysis, and to determine changes in the shoreline and littoral zones. Mr. Hair has also served as an expert CAD/survey analyst in support of court cases involving erosion.

TECHNICAL EXPERIENCE

Extensive data collection experience including field investigations of project sites, installation of coastal engineering instrumentation, and collection of samples for testing. Mr. Hair is proficient in survey processes from the initial setup of projects to data reduction and map production utilizing the latest technology and software.

Responsibilities include obtaining state and federal permits, production of all of CSE's construction plans/specifications and processing collected data. He has extensive experience in large projects, including two of the largest locally funded beach nourishment projects ever completed along the U.S. East Coast at Bogue Banks (NC) and Nags Head (NC) involving volume placement of ~10 million cubic yards of nourishment fill.

Mr. Hair has performed underwater assessments of revetments, seawalls, and coastal structures, as well as reconnaissance surveys for a directional-drilling project. He is a master diver with hundreds of dives logged in support of project design; collecting sediment samples and setting coastal analysis instrumentation for the study of tides, waves, and currents (ADP, MD, XR, mini-wave, etc).

EDUCATION

AS. Engineering Technology, Midlands Technical College

PROFESSIONAL CERTIFICATIONS

PADI Open-Water Certified Diver/ TDI Nitrox
Engineering Graphics (MTC)
3-D Design (MTC)
Civil Design (AutoDesk® University)
AutoCAD Civil 3D Certified Professional

MEMBERSHIPS

AUGI AutoDesk® User Group International
AutoDesk® Certified Professionals
American Shore & Beach Preservation Association

SOFTWARE PROGRAM CAPABILITIES

- AutoDesk® Civil 3D/Map/Raster Design
- AutoDesk® Infrastructure Design Suite
- ESRI ArcMapGIS
- Trimble®/HYPACK®
- Global Mapper® (Blue Marble)

MAJOR PROJECTS

Cooper River Bridge Hydrographic Study
Asharoken (NY) Erosion Case
Bogue Banks (NC) Nourishment
Hunting Island (SC) Nourishment
Edisto Beach (SC) Nourishment and Groin Repair
Nags Head Beach (NC) Nourishment
Folly Beach (SC) Groin Design
Al Khiran Monitoring (Kuwait)
Kiawah Island (SC) Beach Restoration
Edisto Island (SC) Nourishment
Isle of Palms (SC) Beach Restoration
Seabrook Is (SC) Capt Sams Inlet Relocation
Sagaponack Beach (NY)
Bridgehampton Beach (NY)
Buxton, Dare County (NC)
Arcadian Shores, Horry County (SC)

APPENDIX B

Equipment Information

Trimble R12i

GNSS SYSTEM

KEY FEATURES

- Trimble® Inertial Platform™ (TIP) technology. Calibration-free and magnetically immune IMU-based tilt compensation for topo measurements and stakeout.
- Trimble ProPoint™ GNSS positioning engine. Engineered for improved accuracy and productivity in challenging GNSS conditions.
- 672-channel solution with Trimble 360 satellite tracking technology
- CenterPoint® RTX correction service delivers fast, RTK level accuracy worldwide via satellite/IP
- Trimble xFill® correction outage technology
- Optimized for Trimble Access™ field software
- Android™ and iOS platform support
- Cellular, Bluetooth®, Wi-Fi data connectivity
- Military-spec rugged design and IP-67 rating
- Ergonomic form factor
- All day battery with built-in status indicator
- 6 GB internal memory
- Supports augmented reality capabilities through Trimble SiteVision™

Learn more:
geospatial.trimble.com/R12i

Tilt Compensation

Trimble AR Ready

PERFORMANCE SPECIFICATIONS

GNSS MEASUREMENTS

Constellation agnostic, flexible signal tracking, improved positioning in challenging environments[1] and inertial measurement integration with Trimble ProPoint GNSS technology.

Increased measurement and stakeout productivity and traceability with Trimble TIP™ technology IMU-based tilt compensation

Advanced Trimble Custom Survey GNSS chips with 672 channels

Reduced downtime due to loss of radio signal or cellular connectivity with Trimble xFill technology

Signals tracked simultaneously	GPS: L1C, L1C/A, L2C, L2E, L5 GLONASS: L1C/A, L1P, L2C/A, L2P, L3 SBAS (WAAS, EGNOS, GAGAN, MSAS): L1C/A, L5 Galileo: E1, E5A, E5B, E5 AltBOC, E6[2] BeiDou: B1, B1C, B2, B2A, B2B, B3 QZSS: L1C/A, L1S, L1C, L2C, L5, L6 NavIC (IRNSS): L5 L-band: Trimble RTX™ Corrections

Iridium filtering above 1616 MHz allows antenna to be used up to 20 m away from iridium transmitter

Japanese LTE filtering below 1510 MHz allows antenna to be used up to 100 m away from Japanese LTE cell tower

Digital Signal Processor (DSP) techniques to detect and recover from spoofed GNSS signals

Advanced Receiver Autonomous Integrity Monitoring (RAIM) algorithm to detect and reject problem satellite measurements to improve position quality

Improved protection from erroneous ephemeris data

Positioning Rates	1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz

POSITIONING PERFORMANCE[3]

STATIC GNSS SURVEYING		
High-Precision Static		
	Horizontal	3 mm + 0.1 ppm RMS
	Vertical	3.5 mm + 0.4 ppm RMS
Static and Fast Static		
	Horizontal	3 mm + 0.5 ppm RMS
	Vertical	5 mm + 0.5 ppm RMS
REAL TIME KINEMATIC SURVEYING		
Single Baseline <30 km		
	Horizontal	8 mm + 1 ppm RMS
	Vertical	15 mm + 1 ppm RMS
Network RTK[4]		
	Horizontal	8 mm + 0.5 ppm RMS
	Vertical	15 mm + 0.5 ppm RMS
RTK start-up time for specified precisions[5]		2 to 8 seconds
TRIMBLE INERTIAL PLATFORM (TIP) TECHNOLOGY		
TIP Compensated Surveying[6]		
	Horizontal	RTK + 5 mm + 0.4 mm/° tilt (up to 30°) RMS
	Horizontal	RTX + 5 mm + 0.4 mm/° tilt (up to 30°) RMS
IMU Integrity Monitor	Bias monitoring	Temperature, age and shock
TRIMBLE RTX CORRECTION SERVICES		
CenterPoint RTX[7]		
	Horizontal	2 cm RMS
	Vertical	5 cm RMS
	RTX convergence time for specified precisions in Trimble RTX Fast regions	< 1 min
	RTX convergence time for specified precisions in non RTX Fast regions	< 15 min
	RTX QuickStart convergence time for specified precisions	< 1 min
TRIMBLE xFILL[8]		
	Horizontal	RTK[9] + 10 mm/minute RMS
	Vertical	RTK[9] + 20 mm/minute RMS
TRIMBLE xFILL PREMIUM[8]		
	Horizontal	3 cm RMS
	Vertical	7 cm RMS
CODE DIFFERENTIAL GNSS POSITIONING		
	Horizontal	0.25 m + 1 ppm RMS
	Vertical	0.50 m + 1 ppm RMS
	SBAS[10]	typically <5 m 3DRMS

HARDWARE

PHYSICAL

Dimensions (W×H)	11.9 cm x 13.6 cm (4.6 in x 5.4 in)	
Weight	1.12 kg (2.49 lb) with internal battery, internal radio with UHF antenna, 3.95 kg (8.71 lb) items above plus range pole, Trimble TSC7 controller & bracket	
Temperature[11]		
	Operating	−40 °C to +65 °C (−40 °F to +149 °F)
	Storage	−40 °C to +75 °C (−40 °F to +167 °F)
Humidity		100%, condensing
Ingress protection		IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration (Tested and meets the following environmental standards)		
	Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
	Vibration	MIL-STD-810F, FIG.514.5C-1

ELECTRICAL

	Power 11 to 24 V DC external power input with over-voltage protection on Port 1 and Port 2 (7-pin Lemo)
	Rechargeable, removable 7.4 V, 3.7 Ah Lithium-ion smart battery with LED status indicators
	Power consumption is 4.2 W in RTK rover mode with internal radio[12]

Operating times on internal battery[13]		
	450 MHz receive only option	6.5 hours
	450 MHz receive/transmit option (0.5 W)	6.0 hours
	450 MHz receive/transmit option (2.0 W)	5.5 hours
	Cellular receive option	6.5 hours

COMMUNICATIONS AND DATA STORAGE

Serial	3-wire serial (7-pin Lemo)	
USB v2.0	Supports data download and high speed communications	
Radio modem	Fully Integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz, support of Trimble, Pacific Crest, and SATEL radio protocols:	
	Transmit power	2 W
	Range	3–5 km typical / 10 km optimal[14]
Cellular[15]	Integrated, 3.5 G modem, HSDPA 7.2 Mbps (download), GPRS multi-slot class 12, EDGE multi-slot class 12, Penta-band UMTS/HSDPA (WCDMA/FDD) 800/850/900/1900/2100 MHz, Quad-band EGSM 850/900/1800/1900 MHz, GSM CSD, 3GPP LTE	
Bluetooth	Version 4.1[16]	
Wi-Fi	802.11 b,g, access point and client mode, WPA/WPA2/WEP64/WEP128 encryption	
I/O ports	Serial, USB, TCP/IP, IBSS/NTRIP, Bluetooth	
Data storage	6 GB internal memory	
Data format	CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2 input and output	
	24 NMEA outputs, GSOF, RT17 and RT27 outputs, 1 PPS output	

WEBUI

	Offers simple configuration, operation, status, and data transfer
	Accessible via Wi-Fi, Serial, USB, and Bluetooth

SUPPORTED CONTROLLERS & FIELD SOFTWARE

	Trimble TSC7, Trimble T10, Trimble T7, Android and iOS devices running supported apps
	Trimble Access 2020.10 or later

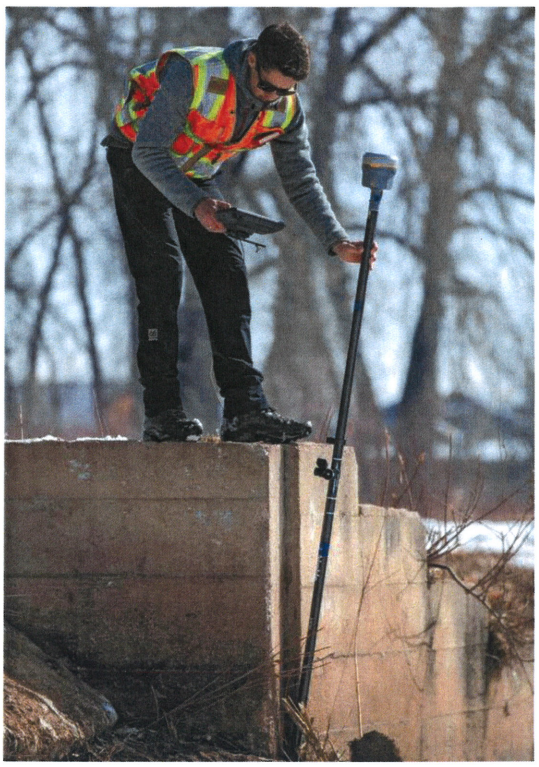
AUGMENTED REALITY

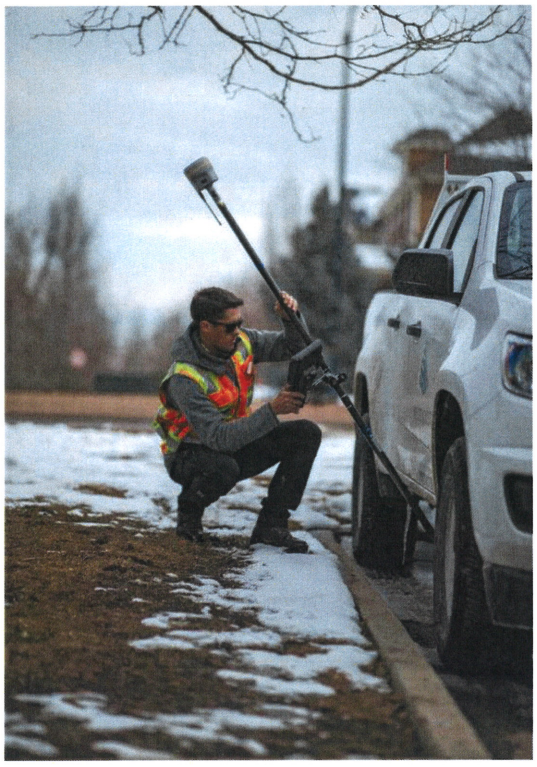
	Supports outdoor augmented reality capabilities through Trimble SiteVision running on the Trimble TSC7 controller

CERTIFICATIONS

	FCC Part 15 (Class B device), 24, 32; CE Mark; RCM; PTCRB; BT SIG

Trimble R12i GNSS SYSTEM





1 Challenging GNSS environments are locations where the receiver has sufficient satellite availability to achieve minimum accuracy requirements, but where the signal may be partly obstructed by and/or reflected off of trees, buildings, and other objects. Actual results may vary based on user's geographic location and atmospheric activity, scintillation levels, GNSS constellation health and availability, and level of multipath and signal occlusion.
2 The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible with a future generation of Galileo satellites or signals.
3 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.
4 Network RTK PPM values are referenced to the closest physical base station.
5 May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
6 TIP references the overall positioning error estimate at the tip of the surveying pole throughout the tilt compensation range. RTK refers to the estimated horizontal precision of the underlying GNSS position, which is dependent on factors that affect GNSS solution quality. The 5 mm constant error component accounts for residual misalignment between the vertical axes of the receiver and the built-in Inertial Measurement Unit (IMU) after factory calibration, assuming the receiver is mounted on a standard 2 m carbon fiber range pole which is properly calibrated and free from physical defects. The tilt-dependent error component is a function of the quality of the computed tilt azimuth, which is assumed here to be aligned using optimal GNSS conditions.
7 RMS performance based on repeatable in field measurements. Achievable accuracy and initialization time may vary based on type and capability of receiver and antenna, user's geographic location and atmospheric activity, scintillation levels, GNSS constellation health and availability and level of multipath including obstructions such as large trees and buildings.
8 Accuracies are dependent on GNSS satellite availability. xFill positioning without an xFill Premium subscription ends after 5 minutes of radio downtime. xFill Premium will continue beyond 5 minutes providing the solution has converged, with typical precisions not exceeding 3 cm horizontal, 7 cm vertical. xFill is not available in all regions, check with your local sales representative for more information.
9 RTK refers to the last reported precision before the correction source was lost and xFill started.
10 Depends on SBAS system performance.
11 Receiver will operate normally to –40 °C, internal batteries are rated from –20 °C to +60 °C (ambient +50 °C).
12 Tracking GPS, GLONASS and SBAS satellites.
13 Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used.
14 Varies with terrain and operating conditions.
15 Due to local regulations, the integrated cellular modem cannot be enabled in China, Taiwan, or Brazil. A Trimble controller integrated cellular modem or external cellular modem can be used to obtain GNSS corrections via an IP (Internet Protocol) connection.
16 Bluetooth type approvals are country specific.

Specifications subject to change without notice.

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GERMANY

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#13-02 HarbourFront Tower Two
Singapore 099254
SINGAPORE

PN 022516-511B (10/20)

Trimble R10

GNSS SYSTEM

A NEW LEVEL OF PRODUCTIVITY

Collect more accurate data faster and easier – no matter what the job or the environment, with the Trimble® R10 GNSS System. Built with powerful technologies like Trimble HD-GNSS, Trimble SurePoint™, Trimble CenterPoint® RTX, and Trimble xFill®, integrated into a sleek design, this unique system provides Surveyors with a powerful way to increase productivity in every job, every day.

The next generation of core positioning technology

The advanced Trimble HD-GNSS processing engine provides markedly reduced convergence times as well as high position and precision reliability while reducing measurement occupation time. Transcending traditional fixed/float techniques, it provides a more accurate assessment of error estimates than traditional GNSS technology.

Faster measurements, increased accuracy, and greater quality control

With this system, surveyors don't have to switch focus from the controller screen to the pole bubble to check that the pole is plumb. The Trimble controller displays an electronic bubble.

The system constantly monitors pole tilt and compensates while the point is automatically or manually measured. If a point is measured with pole tilt beyond a user-defined setting, Trimble Access™ software will give an alert and prompt the surveyor to accept or discard the point. Trimble SurePoint even uses the pole tilt as a controlling input. After a point is measured, tilting the pole causes the system to automatically prepare to measure the next point.

As insurance that all of your data is traceable, the Trimble R10 can record the pole tilt information for measured points. These records include tilt and compass data for 100% data traceability.

Future Proof Your Investment

Powerful Trimble 360 receiver technology in the Trimble R10 supports signals from all existing and planned GNSS constellations and augmentation systems. With two integrated Trimble Maxwell™ 6 chips, the Trimble R10 offers an unparalleled 440 GNSS channels. Trimble delivers business confidence with a sound GNSS investment for today and long into the future.

RTK Level Precision Anywhere

Trimble CenterPoint RTX delivers RTK level precision anywhere in the world without the use of a local base station or Trimble VRS™ Network. Survey using satellite delivered, CenterPoint RTX corrections in areas where terrestrial based corrections are not available. When surveying over a great distance in a remote area, such as a pipeline or utility right of way, CenterPoint RTX eliminates the need to continuously move base stations or maintain connection to a cellular network.

More continuous surveying, less downtime

Leveraging a worldwide network of Trimble GNSS reference stations and satellite datalinks, Trimble xFill seamlessly fills in for gaps in your RTK or VRS connection stream. Extend xFill indefinitely with a subscription to CenterPoint RTX.

Ergonomically Designed

As the smallest and lightest integrated receiver in its class, the Trimble R10 is ergonomically designed to provide the surveyor with effortless handling and operation. Designed for ease of use, the progressive design incorporates a more stable center of mass at the top of the range pole, while its sleeker, taller profile provides the durability and reliability for which Trimble is known.

The Trimble R10 receiver incorporates a quick release adaptor for simple and safe removal of the receiver from the range pole. Additionally the quick release adaptor ensures a solid, stable connection between the range pole and receiver.

An Intelligent Solution

A smart lithium-ion battery inside the Trimble R10 system delivers extended battery life and more reliable power. A built-in LED battery status indicator allows the user to quickly check remaining battery life.

The Trimble R10 system provides a number of communications options to support any workflow. The latest mobile phone technology is built in to receive VRS corrections and connect to the Internet from the field. Access Trimble Connected Community to send or receive documents while away from the office. Using WiFi, easily connect to the Trimble R10 system using a laptop or smartphone to configure the receiver without a Trimble controller.

The Complete Solution: Trimble hardware and software

Bring the power and speed of the Trimble R10 system together with trusted Trimble software solutions, including Trimble Access and Trimble Business Center™.

Trimble Access field software provides specialized and customized workflows to make surveying tasks quicker and easier while enabling teams to communicate vital information between field and office in real time. Back in the office, users can seamlessly process data with Trimble Business Center software.

The R10 GNSS system, a new era of surveying productivity beyond GNSS for professional surveyors.

Key Features

- Cutting-edge Trimble HD-GNSS processing engine
- Precise position capture with Trimble SurePoint technology
- Trimble CenterPoint RTX provides RTK level precision anywhere without the need for a base station or VRS network
- Trimble xFill technology provides RTK coverage during connection outages
- Advanced satellite tracking with Trimble 360 receiver technology
- Sleek ergonomic design for easier handling

Trimble R10 GNSS SYSTEM

PERFORMANCE SPECIFICATIONS

Measurements

- Measuring points sooner and faster with Trimble HD-GNSS technology
- Increased measurement productivity and traceability with Trimble SurePoint electronic tilt compensation
- Worldwide centimeter level positioning using Trimble CenterPoint RTX satellite delivered corrections
- Reduced downtime due to loss of radio signal with Trimble xFill technology
- Advanced Trimble Maxwell 6 Custom Survey GNSS chips with 440 channels
- Future-proof your investment with Trimble 360 GNSS tracking
- Satellite signals tracked simultaneously:
  - GPS: L1C/A, L1C, L2C, L2E, L5
  - GLONASS: L1C/A, L1P, L2C/A, L2P, L3
  - SBAS: L1C/A, L5 (For SBAS satellites that support L5)
  - Galileo: E1, E5a, E5B
  - BeiDou (COMPASS): B1, B2
- CenterPoint RTX, OmniSTAR HP, XP, G2, VBS positioning
- QZSS, WAAS, EGNOS, GAGAN
- Positioning Rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz

POSITIONING PERFORMANCE[1]

	Code differential GNSS positioning
Horizontal	0.25 m + 1 ppm RMS
Vertical	0.50 m + 1 ppm RMS
SBAS differential positioning accuracy[2]	typically <5 m 3DRMS

Static GNSS surveying

High-Precision Static	
Horizontal	3 mm + 0.1 ppm RMS
Vertical	3.5 mm + 0.4 ppm RMS

Static and Fast Static

Horizontal	3 mm + 0.5 ppm RMS
Vertical	5 mm + 0.5 ppm RMS

Real Time Kinematic surveying

Single Baseline <30 km	
Horizontal	8 mm + 1 ppm RMS
Vertical	15 mm + 1 ppm RMS
Network RTK[3]	
Horizontal	8 mm + 0.5 ppm RMS
Vertical	15 mm + 0.5 ppm RMS
RTK start-up time for specified precisions[4]	2 to 8 seconds
Trimble CenterPoint RTX	
Horizontal	4 cm
Vertical	9 cm
RTX convergence time for specified precisions[12]	30 minutes or less
RTX QuickStart convergence time for specified precisions[12]	5 minutes or less
Trimble xFill[5]	
Horizontal	RTK[6] + 10 mm/minute RMS
Vertical	RTK[6] + 20 mm/minute RMS

1 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.
2 Depends on WAAS/EGNOS system performance.
3 Network RTK PPM values are referenced to the closest physical base station.
4 May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
5 Precisions are dependent on GNSS satellite availability. xFill positioning without a RTX subscription ends after 5 minutes of radio downtime. xFill positioning with a RTX subscription will continue beyond 5 minutes providing RTX has converged, with typical precisions not exceeding 6 cm horizontal, 14 cm vertical. xFill is not available in all regions, check with your local sales representative for more information.
6 RTK refers to the last reported precision before the correction source was lost and xFill started.
7 Receiver will operate normally to –40° C, internal batteries are rated to –20° C.
8 Tracking GPS, GLONASS and SBAS satellites.
9 Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used.
10 Varies with terrain and operating conditions.
11 Bluetooth type approvals are country specific.
12 Receiver convergence time varies based on GNSS constellation health, level of multipath, and proximity to obstructions such as large trees and buildings. Convergences times decrease significantly when using a "RTX Quickstart" on a previously surveyed point or a known survey control point.

HARDWARE

Physical

Dimensions (W×H)	11.9 cm x 13.6 cm (4.6 in x 5.4 in)
Weight	1.12 kg (2.49 lb) with internal battery, internal radio with UHF antenna, 3.57 kg (7.86 lb) items above plus range pole, controller & bracket
Temperature[7]	
Operating	–40° C to +65° C (–40° F to +149° F)
Storage	–40° C to +75° C (–40° F to +167° F)
Humidity	100%, condensing
Ingress Protection	IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration	Tested and meets the following environmental standards:
Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
Vibration	MIL-STD-810F, FIG.514.5C-1

Electrical

- Power 11 to 24 V DC external power input with over-voltage protection on Port 1 and Port 2 (7-pin Lemo)
- Rechargeable, removable 7.4 V, 3.7 Ah Lithium-ion smart battery with LED status indicators
- Power consumption is 5.1 W in RTK rover mode with internal radio[8]
- Operating times on internal battery[9]:
  - 450 MHz and 900 MHz receive only option: 5.5 hours
  - 450 MHz and 900 MHz receive/transmit option (0.5 W): 4.5 hours
  - 450 MHz receive/transmit option (2.0 W): 3.7 hours
  - Cellular receive option: 5.0 hours

COMMUNICATIONS AND DATA STORAGE

- Serial: 3-wire serial (7-pin Lemo)
- USB v2.0: supports data download and high speed communications
- Radio Modem: fully Integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz, support of Trimble, Pacific Crest, and SATEL radio protocols:
  - Transmit power: 2 W
  - Range: 3–5 km typical / 10 km optimal[10]
- Cellular: integrated, 3.5 G modem, HSDPA 7.2 Mbps (download), GPRS multi-slot class 12, EDGE multi-slot class 12, UMTS/HSDPA (WCDMA/FDD) 850/1900/2100MHz, Quad-band EGSM 850/900/1800/1900 MHz, GSM CSD, 3GPP LTE
- Bluetooth: fully integrated, fully sealed 2.4 GHz communications port (Bluetooth®)[11]
- WiFi: 802.11 b,g, access point and client mode, WPA/WPA2/WEP64/WEP128 encryption
- External communication devices for corrections supported on – Serial, USB, Ethernet, and Bluetooth ports
- Data storage: 4 GB internal memory; over three years of raw observables (approx. 1.4 MB /day), based on recording every 15 seconds from an average of 14 satellites
- CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2 input and output
- 24 NMEA outputs, GSOF, RT17 and RT27 outputs

WebUI

- Offers simple configuration, operation, status, and data transfer
- Accessible via WiFi, Serial, USB, and Bluetooth

Supported Trimble Controllers

- Trimble TSC3, Trimble Slate, Trimble CU, Trimble Tablet Rugged PC

CERTIFICATIONS

IEC 60950-1 (Electrical Safety); FCC OET Bulletin 65 (RF Exposure Safety); FCC Part 15.105 (Class B), Part 15.247, Part 90; PTCRB (AT&T); Bluetooth SIG; WFA IC ES-003 (Class B); Radio Equipment Directive 2014/53/EU, RoHS, WEEE; Australia & New Zealand RCM; Japan Radio and Telecom MIC

Specifications subject to change without notice.

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Singapore 449269
SINGAPORE

1-inch CMOS Sensor

MasterShots

5.4K Video

12km FHD Transmission [1] [2]

Obstacle Sensing in 4 Directions

ADS-B

Key Features

- 20MP, 1"-type CMOS sensor
- 22mm (equiv.) lens with 88º FOV and fixed F2.8 aperture
- 5.4K/30p, 4K/60p, and 1080p/120p video
- H.264 and H.265 recording at 150 Mbps
- 10-bit D-Log and HDR video capture
- Raw and JPEG image capture
- OcuSync 3.0 (O3) image transmission (12 km range)
- Four-way obstacle avoidance
- APAS 4.0
- 'MasterShots' cinematic capture mode
- 31-minute flight time
- 595g (1.3 pounds) total weight

Safer Skies with ADS-B

DJI Air 2S provides an added layer of airspace safety with the industry-leading AirSense safety system. This receives Automatic Dependent Surveillance-Broadcast (ADS-B) flight location information from airplanes and helicopters in your area that transmit ADS-B signals, displays those aircraft on a map, and provides audio and visual alerts through the DJI Fly app to help you keep the drone out of the way of those aircraft.

Teledyne Odom Hydrographic

Echotrac CV100

Single or Dual Channel Echo Sounder

Compact Survey Solution

Move into the digital age with echo sounders from Teledyne Odom Hydrographic. If your survey does not require traditional paper records, then forget about piles of hard copy – the CV-100 has eliminated all that in favor of digital imaging on a PC-based data acquisition system.

With the same technology as the popular Echotrac CV and Echotrac MKIII, including Ethernet communications, Teledyne Odom's CV100 single or dual channel sounder is ready to simplify your transition to the convenience of an all-digital system.

Photo courtesy of David Evans and Associates, Inc.

PRODUCT FEATURES

- Multiple time varied gain (TVG) curves (10, 20, 30, and 40 log)
- DSP digitizer with manual filter control
- Manual or auto scale changes (phasing)
- Calibration menu with controls for transducer draft and index plus sound velocity and bar depth controls
- Rugged and waterproof (IP67)
- Help menus
- Flash memory upgradeable
- Auto Gain and Auto Power Modes for minimal operator input
- Suitable for autonomous vessels

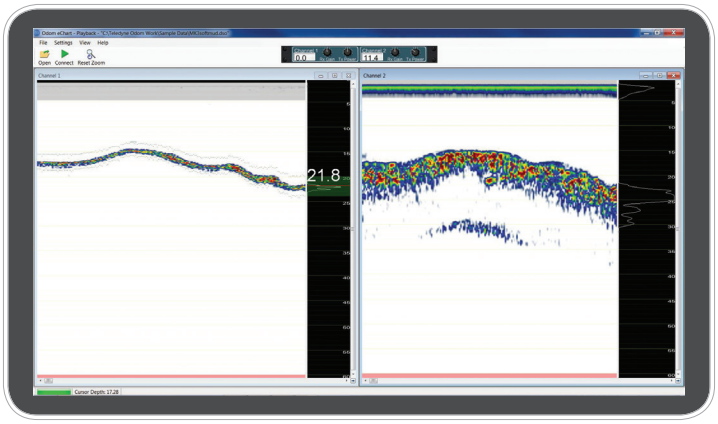
Echotrac CV100

Digital Hydrographic Echo Sounder

TECHNICAL SPECIFICATIONS

Single Channel Configuration[1]	High: 100kHz-750kHz (manual tuning in 1-kHz steps) Low: 3.5kHz-50kHz (manual tuning in 1-kHz steps) variable receiver bandwidth
Dual Channel Configuration	High: 100 kHz-340kHz Low: 24 kHz-50kHz
Resolution	0.01m, 0.1 ft.
Accuracy *(corrected for sound velocity)*	200kHz-0.01 m +/- 0.1% depth 33kHz-0.10 m +/- 0.1% depth
Output Power	Up to 300 watts RMS < 1 watt minimum
Ping Rate	Up to 20Hz in shallow water (10m) range
Depth Range	From <30cm to 600m (depending on frequency and transducer selected)
Input Power Requirement	9-32VDC < 15 watts
Weight	5kg (11lbs)
Dimensions	28cm W (11 in) x 23cm H (9 in) x 11.5cm (4.5 in) D
Mounting	Desktop or bulkhead mount (fixing hardware included)
Ports/Interface	Ethernet (LAN) plus 4 x RS232 or 3 x 232 and 1 x RS422 Inputs from external computer, motion sensor, sound velocity Outputs to external computer or remote display Output string: Odom Echotrac SBT, NMEA DBS, NMEA DBT, DESO 25 Heave Input-TSS1 or "Sounder Sentence" Echotrac Control SW - Simple Windows compatible graphical user interface Storage of full ping to seabed data in DSO format with e-Chart (easily compressed or converted to .XTF for additional processing)
Environmental	Operating 0-50°C Storage -20°-70°C
Options	Heave Sensor
Software Control & Logging Software	Windows based software included: eChart Display

1 Frequency agile in 2 bands (specify band at time of order).



eChart Software.

TELEDYNE
ODOM HYDROGRAPHIC
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POS MV

MAXIMIZE YOUR ROI WITH POS MV SURFMASTER

POS MV SurfMaster is a user-friendly, turnkey system designed and built to provide accurate attitude, heading, heave, position, and velocity data of your marine vessel and onboard sensors.

POS MV is proven in all conditions, and is the georeferencing and motion compensation solution ofchoice for the hydrographic professional.

MV blends GNSS data with angular rate and acceleration data from an IMU and heading from the GPS Azimuth Measurement System (GAMS) to produce a robust and accurate full six degrees-of-freedom position and orientation solution.

Key Features

- Up to 0.03° roll and pitch performance
- IN-Fusion 2.0 ensures optimal GNSS aiding for any given conditions
- TrueHeave - no requirement to tune filter for specific conditions, no settling time so no run in time
- High accuracy inertial measurement units featuring SmartCal
- Data time tagged to microsecond accuracy

POS MV **SURFMASTER**

PERFORMANCE SUMMARY

POS MV SURFMASTER ACCURACY

	DGPS	Fugro Marinestar®	IARTK	POSPac MMS PPP	POSPac MMS IAPPK	Accuracy During GNSS Outage
Position	0.5 - 2 m[1]	Horizontal: 10 cm 95% Vertical: 15 cm 95%	Horizontal: +/- (8 mm + 1 ppm x baseline length)[2] Vertical: +/- (15 mm + 1 ppm x baseline length)[2]	Horizontal: < 0.1 m Vertical: < 0.2 m	Horizontal: +/- (8 mm + 1 ppm x baseline length)[2] Vertical: +/- (15 mm + 1 ppm x baseline length)[2]	~ 6 m for 30 s total outages (RTK) ~ 3 m for 60 s total outages (IAPPK)
Roll & Pitch[3]	0.04°	0.03°	0.03°	< 0.03°	0.025°	0.05°
Heading[3]	0.06° with 4 m baseline 0.08° with 2 m baseline	-		-	-	0.2° (IAPPK, 60 second outage) 0.3° (RTK, 60 second outage)
Heave TrueHeave™	5 cm or 5%[4] 2 cm or 2%[5]	-		-	-	5 cm or 5%[4] 2 cm or 2%[5]

PCS OPTIONS

COMPONENT	DIMENSIONS	WEIGHT	TEMPERATURE	HUMIDITY	POWER
Rack Mount PCS	L = 442 mm, W = 356 mm, H = 46 mm	3.9 kg	-20 °C to +70 °C	10 - 80% RH	AC 120/230 V, 50/60 Hz, auto-switching 40 W
Small Form Factor PCS	L = 167 mm, W = 185 mm, H = 68 mm	2.5 kg	-20 °C to +60 °C	0- 100% RH	DC 10-34 V, 35 W (peak)

INERTIAL MEASUREMENT UNIT (IMU)

ENCLOSURE	DIMENSIONS	WEIGHT	TEMPERATURE	IP RATING
Between Decks	L = 158 mm, W = 158 mm, H = 124 mm	1.66 kg	-40 °C to +60 °C	IP65
Submersible	Ø100 mm (base plate Ø132 mm) X 61 mm[6]	2.4 kg	-40 °C to +60 °C	IP68

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

COMPONENT	DIMENSIONS	WEIGHT	TEMPERATURE	HUMIDITY
GNSS antenna	Ø178 mm, W = 73 mm	0.45 kg	-50 °C to +70 °C	0- 100% RH

ETHERNET INPUT/OUTPUT

Ethernet ..... (10/100 base-T)
Parameters..... Time tag, status, position, attitude, velocity, track and speed, dynamics, performance metrics, raw IMU data raw GNSS data
Display Port ..... Low rate (1 Hz) UDP protocol output
Control Port ..... TCP/IP input for system commands
Primary Port..... Real-time (up to 200 Hz) TCP/IP protocol output
Secondary Port ..... Buffered TCP/IP protocol output for data logging to external device

SERIAL RS232 INPUT OUTPUT

5 COM Ports..... User assignable to: NMEA output (0-5), Binary output (0-5), Auxiliary GNSS input (0-2), Base GNSS correction input (0-2)

NMEA ASCII OUTPUT

Parameters..... NMEA Standard ASCII messages: Position ($INGGA), Heading ($INHDT), Track and Speed ($INVTG), Statistics ($INGST) Attitude ($PASHR, $PRDID), Time and Date ($INZDA, $UTC)
Rate ..... Up to 50 Hz (user selectable)
Configuration..... Output selections and rate individually configurable on each assigned com port

HIGH RATE ATTITUDE OUTPUT

Parameter..... User selectable binary messages: attitude, heading, speed
Rate ..... Up to 200 Hz (user selectable)
Configuration..... Output selections and rate individually configurable on each assigned com port

AUXILIARY GNSS INPUTS

Parameter..... NMEA Standard ASCII messages: $GPGGA, $GPGST, $GPGSA, $GPGSV
Uses Aux input with best quality
Rate ..... 1 Hz

BASE GNSS CORRECTION INPUTS

Parameter..... RTCM V2.x, RTCM V3.x, CMR and CMR+, CMRx input formats accepted. Combined with raw GNSS observables in navigation solution
Rate ..... 1 Hz

DIGITAL I/O

1PPS..... 1 pulse-per-second Time Sync output, normally high, active low pulse
Event Input (2) ..... Time mark of external events. TTL pulses > 1 msec width, rising or falling edge, max rate 200 Hz

USER SUPPLIED EQUIPMENT

- PC for POSView Software (Required for configuration): Pentium 90 processor (minimum), 256 MB RAM, 2 GB free disk space, Ethernet adapter (10/100 Base-T Ethernet; IEEE 802.3 sntandard), Windows 7 SP1, Windows 7 Embedded, Windows 8, and Windows 10
- PC for POSPac MMS Post-processing Software: Intel Pentium series 1Ghz or or faster 64-bit processor (minimum), 2GB RAM, 2.6 GB free disk space, USB Port (For Security Key), Windows 7 SP1, Windows 8.1, Windows 10

[1] Depending on quality of differential corrections
[2] Assumes 1 m IMU-GNSS antenna offset
[3] No range limit
[4] Whichever is greater, for periods of 14 seconds or less
[5] Whichever is greater, for periods of 35 seconds or less
[6] Height excludes connector

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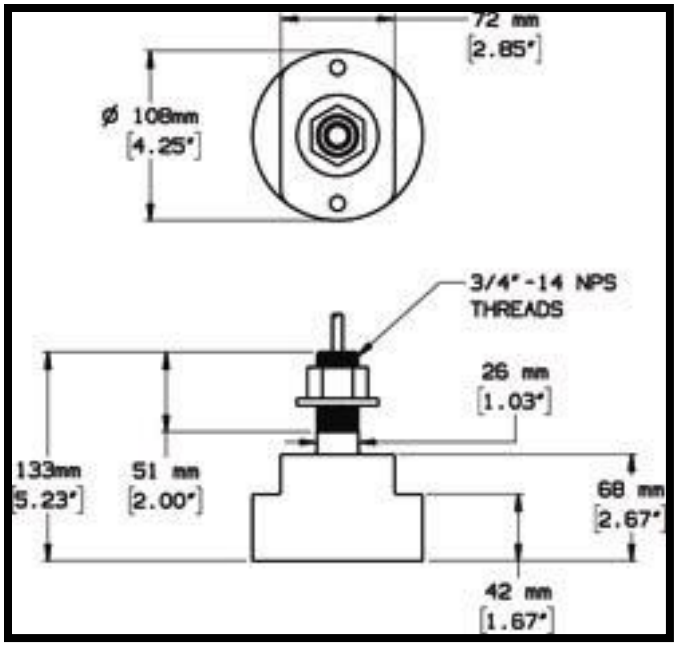
SMSW200-4a



Performance Data

Frequency	200kHz
Beam Width	4°
Q (transmit)	
Rated RMS Power	
Balanced Impedance	60 ohms
Peak Figure of Merit	
Bandwidth	
Acoustic Window Material	Urethane
Threads	¾" –14NPS
Cable Type	C37 (2-20 AWG)
Cable Size	6mm
Weight	1.3Kg.

The compact stainless steel housing is easily adapted to portable or hull mounted applications. This unit is primarily used for shallow and mid-depth survey applications where delineation of steep slopes and sounding in very shallow water are important features. It contains a transformer that matches the impedance of the transducer to that of the echo sounder and allows for the use of longer cables without affecting performance.

CastAway CTD

SPECS

The CastAway®-CTD

with profiling and analysis software

The CastAway-CTD
Accurate, reliable data in the palm of your hand!

The CastAway-CTD is a lightweight, easy to use instrument designed for quick and accurate conductivity, temperature, and depth profiles. Starting with a unique six-electrode conductivity cell and fast response thermistor the CastAway makes use of modern technology to provide state of the art CTD measurements.

The palm-sized CastAway-CTD can easily be deployed from small boats. Each cast is referenced with both time and location using its built-in GPS receiver. Plots of conductivity, temperature, salinity and sound speed versus depth can be viewed immediately on the CastAway's integrated color LCD screen in the field.

The CastAway incorporates the most modern technology available yet is simple to use. It is designed for profiling down to 100 m and is easy to deploy.

The rugged, non-corrosive housing, AA battery power and tool-free operation reflect the technician-friendly pedigree of the CastAway-CTD. Profile data is easily downloaded via Bluetooth to a Windows computer for detailed analysis and/or export. The CastAway software displays profiles of the casts in addition to mapping the locations of the data collection points. Data can also be exported to Hypack or Matlab and integrates with RiverSurveyor software for applying sound speed corrections.

HIGHLIGHTS:

- *5Hz response and sampling rate*
- *Accurate to 0.1 PSU, 0.05°C*
- *Internal GPS*
- *Bluetooth wireless data download*
- *No user calibration required*
- *No tools, computers or cables required*

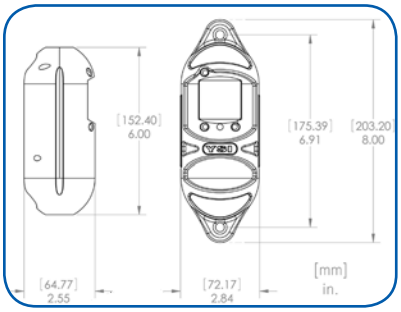
The CastAway-CTD is fully compatible with the RiverSurveyor S5/M9

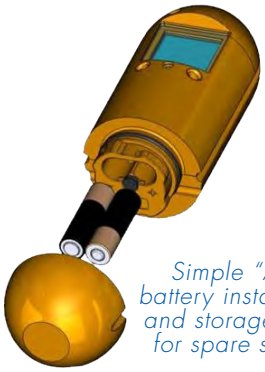
APPLICATIONS:

- Coastal Oceanography
- Hydrology
- Aquaculture/Fisheries
- Saltwater Intrusion
- Surveying/Hydrography
- Sound Velocity Profiles
- Field Sensor Verification
- Estuarine Research

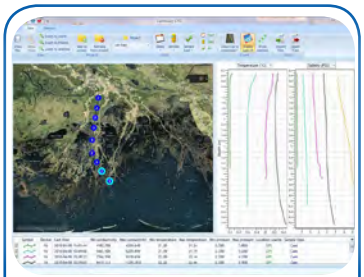
CastAway CTD Specifications

Memory	15 MB (750+ casts based on typical usage)
Communications	Bluetooth class II, up to 10 m range
Power	2 "AA" alkaline batteries, 40 hours continuous use
Data Output Format	- ASCII (CSV) -Hypack -Matlab
Environmental	- Depth range: 0-100 m - Use temperature: -5° to 45° C - Storage temperature: -10° to 50° C
Sampling Modes	- Casting (up/down) - Point sample (moving the unit back and forth)
Software	- Windows XP/Vista/7 - Geo-referenced - Multi-language - Data plots, filtering, import/export
Accessories	- Rugged plastic storage/shipping case - Polyurethane jacket - 15m deployment line - Bluetooth dongle - Two locking carabiners - Three magnetic stylus pens - Cleaning brush
Thermistor Response	Less than 200 ms (5 Hz)
Sampling Rate	5 Hz
Weight	In air: 1.0 lb (0.45 kg) In water: 0.06 lbs (0.03 kg)





Simple "AA" battery installation and storage area for spare stylus.



A screen capture of data from a river delta in Louisiana acquired using a CastAway-CTD. 21 casts were collected in less than 3.5 hours.

Each CastAway ships in this rugged plastic case, complete with accessories and quick start guide.

The CastAway-CTD Output Parameters

	Range	Resolution	Accuracy	Measured or Derived
Conductivity	0 to 100,000 µS/cm	1µS/cm	± 0.25% ± 5 µS/cm	Measured
Temperature	-5° - 45° C	0.01° C	± 0.05° C	Measured
Pressure	0 to 100 dBar	0.01 dBar	± 0.25% FS	Measured
Salinity	Up to 42 (PSS-78)	0.01 (PSS-78)	± 0.1 (PSS-78)	PSS-78[3]
Sound Speed	1400 - 1730 m/s	0.01 m/s	± 0.15 m/s	Chen-Millero[4]
Density[1]	990 to 1035 kg/m^3	0.004 kg/m^3	± 0.02 kg/m^3	EOS80[5]
Depth	0 to 100 m	0.01m	± 0.25% FS	EOS80[5]
Specific Conductivity[2]	0 to 250,000 µS/cm	1µS/cm	± 0.25% ±5 µS/cm	EOS80[5]
GPS			10 m	

[1]Based on temperature resolution and accuracy.
[2]Based on 100,000 µS/cm at -5° C.
[3]1978 Practical Salinity Scale.
[4]Chen-Millero, 1977. Speed-of-sound in sea water at high pressures.
[5]International Equation of State for sea water (EOS-80).

To order, or for more information, contact SonTek at inquiry@sontek.com

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CE

Sound Principles. Good Advice.

sontek.com/castaway

Pro XD Mid-Size Gas

ANSI/OPEI Certification

Polaris Industries Inc. certifies that these vehicles complies with the American National Standard for Multipurpose off-Highway Utility Vehicles, ANSI/OPEI B71.9 – 2016 Standard

Key Specifications

Gas	1,000	200-Hr
Fuel Type	lbs Payload	Maintenance Interval

Engine & Drivetrain

Air Intake	Side Air Intake
Cooling	Liquid
Cylinders Displacement	570 cc
Drive System Type	On-Demand 4x4
Engine Type	ProStar 570 cc Gas
Fuel System/Battery	Electronic Fuel Injection
Horsepower	39.5 HP
Maintenance Interval	200 Hours (25 Hour initial break-in)
Top Speed	Adjustable up to 40 mph (64 km/h)
Transmission/Final Drive	Automatic PVT H/L/N/R/P; Shaft

Dimensions

Bed Box Dimensions (L x W x H)	33.3" x 48.7" x 12.3" (84.6 x 123.7 x 31.2 cm)
Box Capacity	500 lb (226 kg)
Estimated Dry Weight	1,234 lb (560 kg)
Fuel Capacity	9.5 gal (36 L)
Ground Clearance	11 in (27.9 cm)
GVWR	2,255 lb (1023 kg)
Hitch Towing Rating	1,500 lb (680 kg)
Overall Vehicle Size (L x W x H)	108 x 56 x 74 in. (274.3 x 142.2 x 188 cm)
Payload Capacity	946 lb (429 kg)
Person Capacity	2
Turning Radius	148 in (375 cm)
Wheelbase	73 in (185.4 cm)

Brakes

Front/Rear Brakes	4-Wheel Hydraulic Disc
Parking Brake	Park In-Transmission

Additional Specifications

Adjustable Driver Seat	Not Equipped
Cargo System	Lock & Ride®
Hitch Type	Standard 2 in (5 cm) Receiver
Instrumentation	All Digital Gauge, Speedometer, Odometer, Tachometer, 2 Tripmeters, Hour Meter, Gear Indicator, Diff Lock Indicator, Clock, Clutch Belt Slip Warning, Low Oil Pressure Indicator, Seat Belt Indicator
Lighting	55W Headlight, LED Taillamps
Other Standard Features	Horn, Backup Alarm, Password protected, electronically adjustable speed limiting
Seat Covering	Kevlar®-Backed Vinyl (Grey)
Tilt Steering	Standard

Tires / Wheels

Electronic Power Steering	Optional
Front Tires	25 x 9.00-12; Wanda Crawler P3057
Hubs	Front: Ductile Iron; Rear: Aluminum
Rear Tires	25 x 9.00-12 Wanda Crawler P3057
Wheels	12 x 6 HD Steel - Gloss Black

Suspension

Front Suspension	MacPherson Strut 9 in (22.9 cm) Travel
Rear Suspension	Dual A-Arm, IRS 10 in. (25.4 cm) Travel

Ping DSP

www.pingdsp.com

3DSS-iDX *Integrated INS Shallow Water Mapping/Imaging System*

- *3DSS-iDX Sonar*
- *integrated AML Sound Velocity Sensor*
- *integrated INS (SBG IMU and Septentrio GNSS)*
- *ultra-compact and portable*

SUPERIOR SHALLOW WATER HYDROGRAPHY

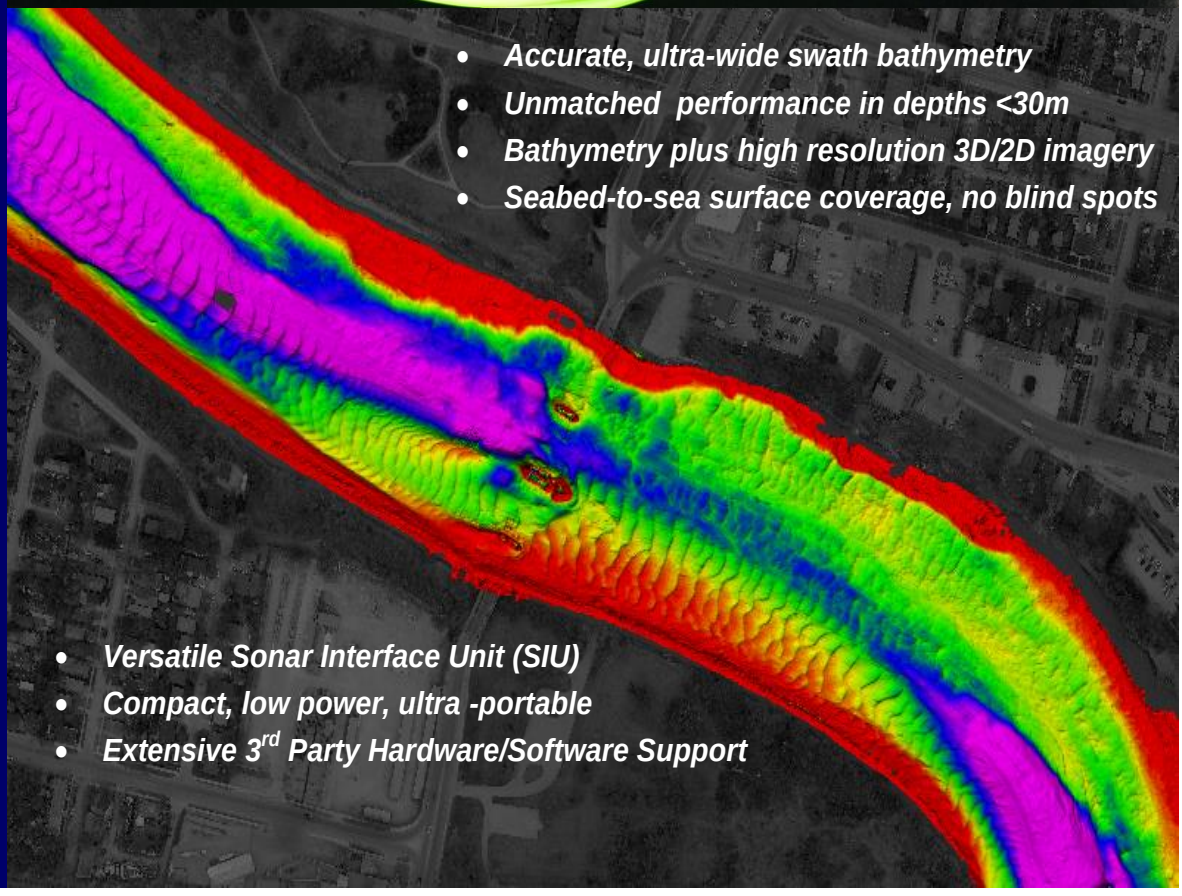
Accurate, high resolution, ultra-wide swath echo-sounding and 3D/2D imagery, with integrated real-time surface sound velocity, high accuracy INS position / attitude and optional RTK, PPK, PPP provide the best available hydrographic survey and imaging performance in shallow water.

SIMULTANEOUS REAL-TIME 3D IMAGERY

Geometrically correct, co-located 3D Sidescan imagery augments bathymetry and extends 2D sidescan resolution to three dimensions. ***3DSS*** real-time 3D software displays, captures and allows accurate measurement in three dimensions of features on the seabed and in the water-column including pipes, cables, pilings, wrecks, subsea structures hazards, ecological habitats, and other features not well defined in bathymetry or 2D sidescan.

COMPACT, ULTRA-PORTABLE, VERSATILE

A versatile Sonar Interface Unit provides ultra-portable, easy turnkey operation with just a laptop and a battery on small boats, USV's, and dedicated survey launches.



- *Accurate, ultra-wide swath bathymetry*
- *Unmatched performance in depths <30m*
- *Bathymetry plus high resolution 3D/2D imagery*
- *Seabed-to-sea surface coverage, no blind spots*

- *Versatile Sonar Interface Unit (SIU)*
- *Compact, low power, ultra -portable*
- *Extensive 3rd Party Hardware/Software Support*

Ping DSP

www.pingdsp.com

For more information please contact ***Ping DSP Inc***. at: ***info@pingdsp.com***

PATENTED ARRAY SIGNAL PROCESSING TECHNOLOGY

3DSS-iDX incorporates a patented signal processing methodology that extends the single angle-of-arrival principle used in interferometric systems to accommodate multiple simultaneous backscatter arrivals. When combined with the ***3DSS-iDX*** Multibeam Echo-Sounder Signal Processing Engine, the result is unsurpassed resolution and bathymetric accuracy over swath widths that can exceed 14 times water depth.

SOFTSONAR™ TECHNOLOGY

At the heart of the ***3DSS-iDX*** sonar is Ping DSP's state-of-the-art ***SoftSonar™*** electronics technology with ultra-low noise, wide dynamic range receivers, state-of-the-art acoustic transducer arrays, Gigabit Ethernet, easy-to-use software interface, and integrated support for a wide range of third party survey software and hardware.

BROAD APPLICATION

- Coastal Hydrographic survey
- River and Lake surveys
- Dredge surveys
- Tailing Pond surveys
- Subsea structure surveying
- Search and localization
- Benthic habitat mapping
- Underwater archaeology

3DSS-iDX Sonar Specifications[1]

Sonar Configurations

Model	*Application*	*SVS*	*IMU*	*GNSS*
3DSS-iDX-BASE	Hydrography + 3D/2D Sidescan - 0.05° IMU, ext GNSS	AML Micro-X	SBG Ellipse2	External
3DSS-iDX-FULL	Turnkey Hydrography + 3D/2D Sidescan - 0.05° IMU	AML Micro-X	SBG Ellipse2	Septentrio AsteRx-m3 Fg
3DSS-iDX-PRO	Turnkey Hydrography + 3D/2D Sidescan - 0.02° IMU	AML Micro-X	SBG Navsight Ekinox	Septentrio AsteRx-m3 Fg

Sonar Specifications

Operating Frequency	450 kHz	Mech. Transducer Tilt (fixed)	20°
Transmit Waveforms	CW, Broadband	Electronic Transmit Tilt	-45° to 45°
Pulse Lengths	10 – 200 cycles	Max. Ping Rep. Rate	~45 Hz
Horizontal Beamwidth (2 way)	0.4°	Vertical Beamwidth (selectable)	19° - 125°

2D Sidescan (2D Imagery) Specifications

Data Output	Range and Amplitude
2D Imaging Swath Width	10 to 20 times sonar altitude, varies with sound velocity profile, geometry and seabed type
Max Range	200m per side
Max Range Resolution	1.67cm

3D Sidescan (3D Imagery) Specifications

Data Output	Range, Angle, and Amplitude
3D Imaging Swath Width	8 to 14 times sonar altitude, varies with sound velocity profile, geometry and seabed type
Max 3D Imaging Range per Side	100m per side
Max Resolution	1.67cm

Bathymetry Specifications

Data Output	Sounding Range, Angle, and Amplitude
Bathymetry Swath Width	8 to 16 times sonar altitude, varies with sound velocity profile, geometry and seabed type
Max Bathymetry Range	120m per side
Min. Sounding Depth	0.5m
Max. Sounding Depth	75m (reduced swath width)
Sounding Accuracy	Exceeds IHO Special Order, meets or exceeds Dutch Norm 1A and Canadian Exclusive Order
Multibeam Eq. Mode Settings	Beamwidth (0.25°-5°), Sector (90°-220°), Beams (3-1024), Mode (Equidistant, Equiangle, Hybrid)
Legacy Mode Settings	Bin Count (3-1440), Bin Width (5cm – 200cm)

Integrated Sensor Specifications

SVS (-BASE, -FULL, -PRO)	AML MicroX[2]	1375 – 1600m/s SV range, 20ms resp, 0.025m/s accuracy
IMU (-BASE,-FULL)	IMU SBG Ellipse2[3]	pitch,roll 0.05°(RTK), hdg 0.2°(2m baseline), heave 5cm
IMU (-PRO)	SBG Navsight Marine Ekinox[3]	pitch,roll 0.02°(RTK), hdg 0.08°(2m baseline), heave 2cm
GNSS (-FULL, -PRO)	Septentrio AsterRx-m3 Fg[4]	dual recvr,, GPS, GLONASS, Galileo, BeiDou, QZSS, SBAS, L-band Rx, fully unlocked for RTK, PPK, PPP, 0.6/1cm vert/horiz. accuracy (RTK)

Interface Specifications

Control Input / Data Output	Gigabit Ethernet, sonar software provides control GUI and TCP data server
Time Reference	Time aligned to GNSS time
Additional Communication Ports	RS-232 or Ethernet, for external MRU, GNSS or INS,
Additional Inputs	PPS (SMA), Ext.Trigger (SMA)
Computer Requirements	PC (Quad Core, 16GB, Discrete GPU (e.g. Nvidia), MS Windows 7,8, 10 (64 bit)
3rd Party Software Support	Hypack, SonarWiz, QINSy, PDS, BeamWorx, Caris HIPS/SIPS

Physical Specifications

Voltage Requirements	12-28 VDC
Power Consumption	25W (***-BASE***), 28W (***-FULL, -PRO***)
Sonar Head Dimensions	61 cm (24") long x 9.8cm (3.88") diameter
Sonar Head Weight in Air, Water	8.5 kg (18.7 lbs), 5 kg (11 lbs)
Sonar Interface Unit Dimensions	25.5cm (10.04") wide x 15.5cm (6.10") deep x 5.8cm (2.28") tall
Pole Mount Adapter Diameter	1.49" (fits standard thickwall 1.5" I.D. Aluminum pipe), Flange mount adapter also included
Ambient Operating Temp.	-5° C – 45° C
Depth Rating	10 m

Notes:

1. Specifications subject to change without notice.
2. See www.amloceanographic.com for complete specifications.
3. Specifications given for integrated 3DSS-INS operation and RTK corrections, see www.sbg-systems.com for full specifications.
4. See www.septentrio.com for complete specifications.