

## MEMORANDUM

**DATE** December 14, 2018

**PROJECT NO.** 2018-0078-00

**TO** Town of Wareham  
Planning Department

**FROM** Woods Hole Group  
Direct Phone: (508) 540-8080

### **Task 1.4 Technical Memorandum – Data Collection and Identification of Target Features (DRAFT)**

The Town of Wareham has contracted with Woods Hole Group to complete a Climate Change Flood Vulnerability Assessment and Adaptation Planning project. The goals of this project are to:

- Provide data on likely future flooding scenarios;
- Identify potential flooding impacts to municipally-owned infrastructure;
- Identify potential sea level rise impacts to natural resources;
- Identify potential flooding impacts to specific population demographics;
- Identify potential adaptation strategies to reduce risk;
- Prioritize investments in adaptation strategies; and
- Produce high-quality maps and graphics that can be used to disseminate project results to decision makers and the general public.

This memorandum provides documentation of the initial project phase to select study parameters for the Town of Wareham Climate Change Flood Vulnerability Assessment and Adaptation Planning project. Major tasks accomplished during this phase of the project include 1) selecting a model and determining the tidal, sea level rise and surge parameters, as well as choosing which out years and storm probabilities with which to evaluate specific risks, and 2) collecting relevant datasets to compile an initial list of municipal assets.

#### **1. Selection of model and determination of input parameters**

The hydrodynamic modeling utilized for this study simulates a full suite of processes that affect coastal water levels, including tides, waves, winds, storm surge, sea level rise, and wave set-up at a fine enough resolution to identify site-specific locations that may require adaptation alternatives. Water surface elevations were modelled using the Advanced Circulation (ADCIRC) software to predict storm surge flooding coupled with the Simulated Waves Nearshore (SWAN) software, a wave generation and transformation model. This modeling was performed as part of the Massachusetts Coast Flood Risk Model (MC-FRM), which was developed for the Massachusetts Department of Transportation (MassDOT) to assess potential flooding vulnerabilities to highways and other transportation infrastructure throughout the state of Massachusetts. Since the MC-FRM domain includes the entire Massachusetts coastal area, including the Town of Wareham, this model is ideally suited to assess the vulnerability and risk of coastal flooding to Wareham's infrastructure and natural resources. Using this existing model is beneficial to the Town of Wareham since much of the upfront work and cost in developing the model was already conducted as part of the MassDOT project.

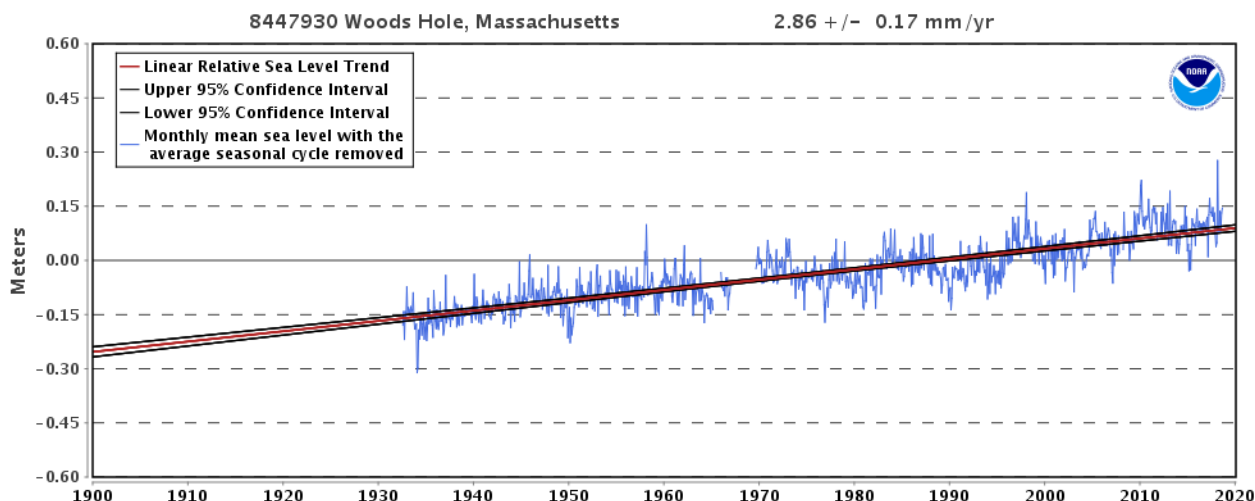


The spatial resolution of the model is 10 meters or less between nodal points, and sometimes as low as 2-3 meters to capture important changes in topography and physical processes related to storm dynamics. This high-resolution model offers more accuracy than other storm surge models, such as the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model developed by the U.S. Army Corps of Engineers (USACE) and the National Oceanic and Atmospheric Administration (NOAA). The MC-FRM is also superior to a more rudimentary “bathtub” approach, since the latter does not account for critical physical processes that occur during a storm event, including waves and winds, nor can it determine the limited volume of water that may be able to enter certain areas, particularly those with narrow entry points.

The model quantitatively incorporates climate change influences on sea level rise, tides, waves, storm track, and storm intensity for 2030, 2050, 2070, and 2100 time horizons, providing discrete risk estimates at various time horizons to assist with both near- and long-term planning. To do so, it evaluates a statistically-robust sample of storms, including hurricanes, tropical storms and nor’easters, based on the region’s existing and evolving climatology. Using this storm set, the model then calculates resulting water elevations to estimate the probability that different flood depths will be exceeded at each nodal point within the model boundary. The resulting flood risk maps and probability curves can then be interpreted using geographic information systems (GIS) to identify the estimated annual probability, or likelihood, that any node within the model will experience flooding, and if so, up to what elevation.

The probability-based approach of the proposed modeling will be beneficial to the Town when assessing the vulnerability of and risk to infrastructure and when developing adaptation strategies to mitigate future flooding damage. It will also produce information that can be used to inform engineering design criteria since it provides the probability of an event occurring in this changing regime, such as the “new” 1% event flood levels (equivalent to a 100 year recurrence water level). In particular, an accurate and precise assessment of the exceedance probability of combined SLR and storm surge is provided that can help Town managers and decision makers identify areas of existing and near-term vulnerability requiring immediate action in Wareham, as well as areas that will benefit from long-range planning for future preparedness and risk reduction.

The relative sea-level rise (RSLR) projections used in the MC-FRM represent the most up-to-date RSLR projects for the Massachusetts coastline (Douglas et al., 2016, Climate Change and Sea Level Rise Projections for Boston), drawing on long-term water level datasets from a series of tide gages around the state. For Wareham, RSLR was estimated using the nearby NOAA tidal gage at Woods Hole (station ID 8447930), which has recorded an increase in relative mean sea level of 2.86 mm (+/- 0.17 mm) annually based on monthly mean sea level data from 1932 to 2017 (Figure 1). This equates to approximately 9.5 inches of mean sea-level rise over the last 85 years. Over that same time period, the global rate of sea level rise was about 1.7 mm annually (approximately 5.7 inches over the last 85 years). This significant difference between the RSLR experienced locally and the global SLR trend highlights the importance of accounting for local conditions.



**Figure 1. Mean sea-level rise trend at the Woods Hole tide gage (#8447930).**

In order to compare future mean sea level to “present day” conditions, a starting elevation for mean sea level must be calculated. A tidal-epoch, a 19-year time period, is traditionally used to calculate tidal datums. For this study, the 19-year tidal-epoch with a mid-point year of 2000 (i.e., 1991-2009) was used to calculate a starting elevation for mean sea level. Based on this methodology, the mean sea level in Woods Hole in the year 2000 was at an elevation of -0.30 feet (NAVD88). This 2000 starting elevation of -0.30 feet (NAVD88) can then be used to compare to projected relative mean sea-level elevations at 2030, 2050, 2070 and 2100 under various scenarios (Table 1). Note that the values in Table 1 are elevations of the projected mean sea level at various times relative to a vertical datum of NAVD88, not the magnitude of change in elevation. For comparison, the baseline (i.e., year 2000) mean sea level elevation, is -0.30 feet (NAVD88). Based on the projected sea level elevations presented in Table 1, this means there is a projected change in mean sea level rise of 1.4, 2.7, 4.5 and 8.0 feet between the year 2000 and 2030, 2050, 2070 and 2100, respectively, based on the “High” SLR scenario.

The data in Table 1 are recommended by Massachusetts CZM for assessing sea-level rise, and are being used by the Massachusetts Department of Transportation and other state agencies and communities for vulnerability assessments. As such, these sea-level rise projections were incorporated into the MC-FRM. The “High” SLR scenario was chosen for the MC-FRM because MassDOT and the state were interested in inundation risk probabilities that were unlikely to be exceeded (there is a 99.5% confidence level that the “High” scenario chosen will not be exceeded). In addition, selecting the “High” scenario also allows for the evaluation of inundation risk probabilities under other scenarios due to the bracketed nature of the results. For example, the “High” results in 2030 are equivalent to “Intermediate” results in 2050, and the “High” results in 2050 are the equivalent to the “Intermediate” results in 2070. In this way, the selected scenarios provide an upper bound of potential risk.

**Table 1. Relative mean sea level (feet NAVD88) for Woods Hole, MA.**

Scenario	Cross-walked probabilistic projections	2030	2050	2070	2100
High	Extremely unlikely to exceed (99.5%) under RCP8.5	1.1	2.4	4.2	7.7
	<ul style="list-style-type: none"> <li>Unlikely to exceed (83%) under RCP8.5 when accounting for possible ice sheet instabilities</li> <li>Extremely unlikely to exceed (95%) under RCP4.5 when accounting for possible ice sheet instabilities</li> </ul>				



The Town of Wareham Climate Change Flood Vulnerability Assessment and Adaptation Planning project will focus on two of the modeled out-years for climate change, sea-level rise and storm surge flood effects: 2030 and 2070. These out-years were selected by a Steering Committee, comprised of multi-departmental working group of municipal staff and committee members, to provide the most useful data for planning (see Appendix A for a list of Steering Committee members). Flood risk probabilities for 2030 represent a near-term risk, which will be useful in driving actionable items now, while flood risk probabilities for 2070 will provide a long-range planning tool that will be particularly useful when planning large capital projects, designing and siting new infrastructure and/or buildings, and guiding municipal bylaws and zoning regulations.

**Probability of flooding will be evaluated at 2030 and 2070 time horizons.**

Probability-based inundation maps will be developed for both of the selected out-years (2030 and 2070). In addition, depth of inundation maps will also be developed for two probability levels. The Town Steering Committee selected the 1% event flood levels (equivalent to a 100-year recurrence water level) as one of the outputs. The 1% probability level was selected because this is the benchmark for the Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs). Although FEMA FIRMs are not forward-looking and do not incorporate sea-level rise into the mapping, FEMA does periodically update their modeling to account for increased sea level rise that has occurred (as well as other changes, such as changes in topography or armoring of particular areas). As such, the 2030 and 2070 1% probability of inundation extents may provide a projection for the expected future FEMA flood zones.

The Steering Committee decided to defer the selection of the second probability level for the development of depth of inundation maps until the probability results could be reviewed. There was a general consensus among the Steering Committee members that they would like to select a more probable storm event (e.g., 2% [50-year] or 5% [20-year]) for the second probability level, as opposed to a worst case scenario (e.g., the 0.2% [500-year] or the 0.1% [1000-year] water level). However, the Wareham Steering Committee determined that it would be prudent to wait until there was more information about which probability level storm event might impact more Town assets.

**Depth of flooding maps will be created for the 1% probability level. A second probability level for the depth of flooding map output will be selected after the results are reviewed.**



## 2. Collect municipal asset data

A risk-based vulnerability assessment will be performed in the second Phase of this project to evaluate the flood risk to municipally-owned assets, as well as assets owned by the local Fire Districts and the Wareham Historical Society. Collectively these assets will be referred to as “Town-owned assets”. This Phase of the project focused on developing a thorough Town-owned asset list that will be used for the vulnerability assessment. The landward extent of the MC-FRM grid is set at an elevation of 8 meters (26.2 feet) NAVD88. Because much of the northern part of Town is higher than this elevation, this area is excluded from the model (Figure 2), and any Town-owned asset within it will be screened out from further analysis, since it would have no risk from coastal flooding through 2100. An elevation of 8 meters was chosen as an inland extent because this elevation is well above the projected extent of inundation even during a large storm in 2100.

Woods Hole Group worked cooperatively with the Steering Committee to compile existing GIS-based data and information about locations of Town assets. Based on discussions with the Steering Committee, the following Town-owned assets within the model extent (Figure 2) will be included in the vulnerability assessment:

- Buildings and structures (150)
  - Including above ground utilities (e.g., wastewater pumping stations)
- Boat ramps (3), docks/piers (5), and aquaculture facilities (1)
- Recreational facilities (e.g., baseballs fields, basketball courts, etc.) (17)
- Coastal parking lots (7)
- Roads/bridges (all within model grid)

For a full list of municipally-owned assets that will be included in the vulnerability assessment, see Appendix B.

In addition to the built assets listed above, impacts to population demographics, as well as natural resources, including beaches, coves and salt marshes, will be assessed on a semi-quantitative basis. To address impacts to the population, the Steering Committee initially considered drawing from the 2010 census data, the Massachusetts Environmental Justice Community data, and the FEMA repetitive loss properties database for Wareham to address impacts to demographics and specific segments of the population. However, based on discussions with the Steering Committee and advice from Massachusetts Office of Coastal Zone Management (CZM), it was decided that it would be more useful to evaluate the entire Town on a neighborhood-by-neighborhood level. Neighborhood delineations used for the evaluation are shown in **Figure 3 (Figure to be added; Ken Buckland to provide neighborhood breakdown)**. Woods Hole Group will summarize the risk to the developed residential parcels within each neighborhood (i.e., the number of parcels within each risk probability area will be quantified using the risk associated with the centroid of each developed residential parcel).

To evaluate impacts to natural resources, Woods Hole Group will use the data developed for CZM to model the effects of sea-level rise on coastal wetlands and natural resources statewide. The software Sea Level Rise Affecting Marshes Model (SLAMM) was used to assess the impacts to natural resources for that project. Final model results for the 2030 and 2070 out years for the “High” SLR projection will be incorporated into this study.

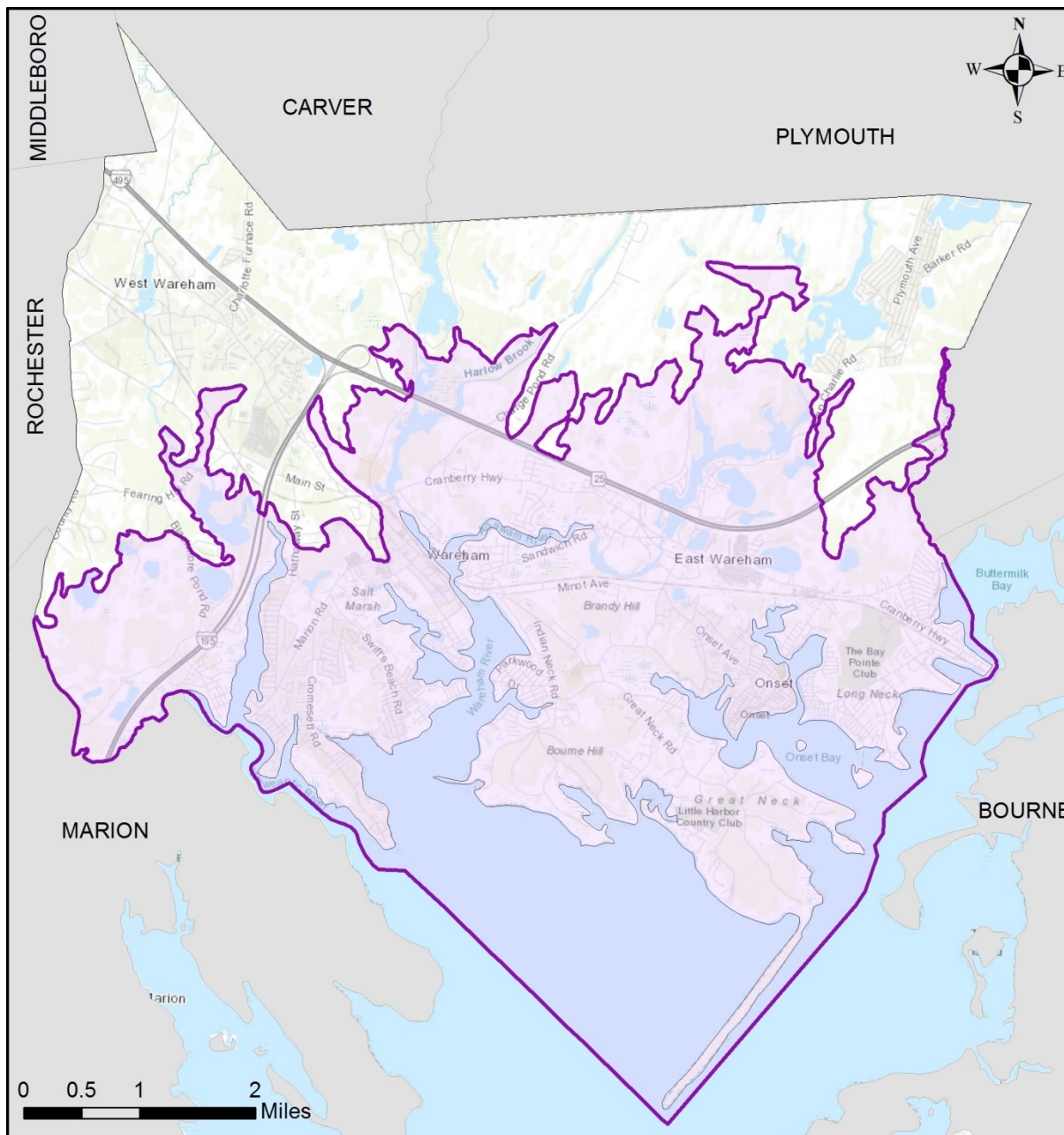


Figure 2. Extent of model grid in Wareham.



## **Appendix A: Steering Committee Members**



Steering Committee Members:

1. Ken Buckland, Town Planner
2. David Pichette, Conservation Administrator
3. Patrick MacDonald, Emergency Management Director
4. Dave Menard, Director of Municipal Maintenance
5. Raymond Goodwin, Onset Fire Department
6. Glenn Barrows, Municipal Maintenance
7. Guy Campinha, Water Pollution Control Facility Director
8. Garry Buckminster, Harbormaster
9. Jasmin Farinacci, Planning Department Assistant





## **Appendix B: Inventory of Municipal Assets**



**Table A-1. Town-owned assets**

#	Asset Name	Asset Type	Type Detail
1	Cape Verdean Culture Center	Building/Structure	Admin
2	Multi-Service Center	Building/Structure	Admin
3	Multi-Service Center Shed	Building/Structure	Admin
4	Town Hall	Building/Structure	Admin
5	Train Station Parking Lot Restrooms	Building/Structure	Admin
6	WCTV Building	Building/Structure	Admin
7	Agawam Cemetery Garage	Building/Structure	Cemetery
8	Tihonet Road Cemetary Building (Vacant)	Building/Structure	Cemetery
9	Parker Mills Pond Dam (Ownership Unknown)	Building/Structure	Dam
10	East Wareham Firestation (Minot Ave)	Building/Structure	Emergency
11	Emergency Medical Services	Building/Structure	Emergency
12	Old Onset Fire Station - Cold Storage	Building/Structure	Emergency
13	Onset Fire Department	Building/Structure	Emergency
14	Onset Fire Department Fuel Farm & Generator	Building/Structure	Emergency
15	Police Department Onset Substation	Building/Structure	Emergency
16	Proposed Fire District Building - 8 Sand Pond Rd	Building/Structure	Emergency
17	Wareham Fire District Fire Department	Building/Structure	Emergency
18	Wareham Fire District Headquarters/Admin (Main St)	Building/Structure	Emergency
19	Captain John Kendrick Maritime Museum	Building/Structure	Historical
20	Fearing Tavern Museum	Building/Structure	Historical
21	Great Neck Union Chapel	Building/Structure	Historical
22	Old District School No. 6	Building/Structure	Historical
23	Old Methodist Meeting House	Building/Structure	Historical
24	Tremont Nail - Freight Building	Building/Structure	Historical
25	Tremont Nail - Nail Factory	Building/Structure	Historical
26	Tremont Nail - Packaging Building	Building/Structure	Historical
27	Tremont Nail - Pickling Building	Building/Structure	Historical
28	Tremont Nail - Shed	Building/Structure	Historical
29	Tremont Nail - Steel Building	Building/Structure	Historical
30	Agawam Village (Sandwich Rd) - Building 1	Building/Structure	Housing Authority
31	Agawam Village (Sandwich Rd) - Building 2	Building/Structure	Housing Authority
32	Agawam Village (Sandwich Rd) - Building 3	Building/Structure	Housing Authority
33	Agawam Village (Sandwich Rd) - Building 4	Building/Structure	Housing Authority
34	Agawam Village (Sandwich Rd) - Building 5	Building/Structure	Housing Authority
35	Agawam Village (Sandwich Rd) - Com. Bldg/Office	Building/Structure	Housing Authority
36	Red Wood Park (Church Ave) - Building A	Building/Structure	Housing Authority
37	Red Wood Park (Church Ave) - Building B	Building/Structure	Housing Authority
38	Red Wood Park (Church Ave) - Building C	Building/Structure	Housing Authority



**Table A-1 (continued). Town-owned assets**

#	Asset Name	Asset Type	Type Detail
39	Red Wood Park (Church Ave) - Building D	Building/Structure	Housing Authority
40	Red Wood Park (Church Ave) - Building E	Building/Structure	Housing Authority
41	Red Wood Park (Church Ave) - Building F	Building/Structure	Housing Authority
42	Red Wood Park (Church Ave) - Building G	Building/Structure	Housing Authority
43	Red Wood Park (Church Ave) - Building H	Building/Structure	Housing Authority
44	Red Wood Park (Church Ave) - Community Bldg	Building/Structure	Housing Authority
45	Red Wood Park (Church Ave) - Maintenance Shed	Building/Structure	Housing Authority
46	Red Wood Park (Church Ave) - Pump House	Building/Structure	Housing Authority
47	Spinney Memorial Library	Building/Structure	Library
48	Harbormaster Building & Restrooms	Building/Structure	Marine
49	Onset Pier Parking Booth	Building/Structure	Marine
50	Onset Pier Rental Hut	Building/Structure	Marine
51	Buzzards Bay Coalition Exploration Center	Building/Structure	Recreation
52	Little Harbor Restrooms	Building/Structure	Recreation
53	McDuffy Annex (School Supplies/Chairs/Tables)	Building/Structure	Recreation
54	Old Boys and Girls Club (Weight Room/Plow Storage)	Building/Structure	Recreation
55	Onset Band Stand	Building/Structure	Recreation
56	Onset Gazebo	Building/Structure	Recreation
57	Onset Park Restrooms	Building/Structure	Recreation
58	Palmer Baseball Field - Dugout (east)	Building/Structure	Recreation
59	Palmer Baseball Field - Dugout (west)	Building/Structure	Recreation
60	Spillane Field - Bleachers (south)	Building/Structure	Recreation
61	Spillane Field - Bleachers (west)	Building/Structure	Recreation
62	Spillane Field - Bleachers and Press Box	Building/Structure	Recreation
63	Spillane Field - Clothes Bin for Donations	Building/Structure	Recreation
64	Spillane Field - Dugout (south)	Building/Structure	Recreation
65	Spillane Field - Dugout (west)	Building/Structure	Recreation
66	Spillane Field - Fields & Grounds Big Shed	Building/Structure	Recreation
67	Spillane Field - Fields & Grounds Trailer/Office	Building/Structure	Recreation
68	Spillane Field - Light Shed	Building/Structure	Recreation
69	Spillane Field - Shed (Bobcat/Blowers/Pumps)	Building/Structure	Recreation
70	Spillane Field - Shed (Templates/Sprinklers)	Building/Structure	Recreation
71	Spillane Field - Snack Bar	Building/Structure	Recreation
72	Spillane Field - Storage Containers	Building/Structure	Recreation
73	Spillane Field - Storage Containers (Push Mowers)	Building/Structure	Recreation
74	Spillane Field - Storage for Gator Machine	Building/Structure	Recreation
75	Spillane Field - Storage Shed	Building/Structure	Recreation
76	Wareham Schools South Baseball Field Shed	Building/Structure	Recreation



**Table A-1 (continued). Town-owned assets**

#	Asset Name	Asset Type	Type Detail
77	East Wareham Elementary School (vacant)	Building/Structure	School
78	Ethel E. Hammond School (Boys & Girls Club)	Building/Structure	School
79	Minot Forest School	Building/Structure	School
80	Proposed New Minot Forest School	Building/Structure	School
81	Supply Shed (Behind McDuffy Annex)	Building/Structure	School
82	Wareham High School	Building/Structure	School
83	Wareham High School - Shed	Building/Structure	School
84	Wareham Middle School	Building/Structure	School
85	Apple Street Pump Station	Building/Structure	Sewer
86	Arnold Pump Station	Building/Structure	Sewer
87	Avenue A Street Pump Station	Building/Structure	Sewer
88	Bay Street Ejector	Building/Structure	Sewer
89	Briarwood Beach Pump Station	Building/Structure	Sewer
90	Cohasset Narrows Pump Station	Building/Structure	Sewer
91	Cromesett Pump Station	Building/Structure	Sewer
92	Depot Street Pump Station	Building/Structure	Sewer
93	Dick's Pond Pump Station	Building/Structure	Sewer
94	East Boulevard Ejector	Building/Structure	Sewer
95	French Pump Station	Building/Structure	Sewer
96	Greene Street Ejector	Building/Structure	Sewer
97	Hathaway Pump Station	Building/Structure	Sewer
98	Hill Street Pump Station	Building/Structure	Sewer
99	Hynes Field Pump Station	Building/Structure	Sewer
100	Indian Neck Pump Station	Building/Structure	Sewer
101	Kennedy Lane Pump Station	Building/Structure	Sewer
102	Leonard Pump Station	Building/Structure	Sewer
103	Linwood Avenue Pump Station	Building/Structure	Sewer
104	Mattapoisett Pump Station	Building/Structure	Sewer
105	Minot Avenue Pump Station	Building/Structure	Sewer
106	Nanumett Street Air Station	Building/Structure	Sewer
107	Narrows Pump Station	Building/Structure	Sewer
108	North Boulevard Pump Station	Building/Structure	Sewer
109	Oak Street Pump Station - Generator?	Building/Structure	Sewer
110	Oak Street Pump Station - Vault?	Building/Structure	Sewer
111	Onset Heights Pump Station	Building/Structure	Sewer
112	Onset Pier Pump Station	Building/Structure	Sewer
113	Parkwood Pump Station	Building/Structure	Sewer
114	Peter Copper Drive Pump Station	Building/Structure	Sewer



**Table A-1 (continued). Town-owned assets**

#	Asset Name	Asset Type	Type Detail
115	Pine Tree Estates Pump Station	Building/Structure	Sewer
116	Pinehurst Pump Station	Building/Structure	Sewer
117	Riverside Pump Station	Building/Structure	Sewer
118	Ruggles Pump Station	Building/Structure	Sewer
119	Salt Works Road Pump Station	Building/Structure	Sewer
120	Smith Avenue Pump Station	Building/Structure	Sewer
121	South Boulevard Ejector	Building/Structure	Sewer
122	South Water Pump Station	Building/Structure	Sewer
123	Thirteenth Street Pump Station	Building/Structure	Sewer
124	Woodbury Street Ejector	Building/Structure	Sewer
125	WPCF - 1000kw Generator	Building/Structure	Sewer
126	WPCF - Admin Building	Building/Structure	Sewer
127	WPCF - Dewatering Building	Building/Structure	Sewer
128	WPCF - Electrical Switching Building	Building/Structure	Sewer
129	WPCF - Filter Blower Building	Building/Structure	Sewer
130	WPCF - Grease Processing Building	Building/Structure	Sewer
131	WPCF - Head Works Building	Building/Structure	Sewer
132	WPCF - Operational Building	Building/Structure	Sewer
133	WPCF - Septage Receiving Building (north)	Building/Structure	Sewer
134	WPCF - Septage Receiving Building (south)	Building/Structure	Sewer
135	WPCF - Sludge Holding Tanks	Building/Structure	Sewer
136	WPCF - Small Garage	Building/Structure	Sewer
137	District Water Building - 5 Sand Pond Road	Building/Structure	Water
138	Maple Springs Corrosion Control Building	Building/Structure	Water
139	Maple Springs Well 1	Building/Structure	Water
140	Maple Springs Well 2	Building/Structure	Water
141	Maple Springs Well 3	Building/Structure	Water
142	Maple Springs Well 4	Building/Structure	Water
143	Sand Pond Road - Pumping Station (not active)	Building/Structure	Water
144	Sand Pond Road - Storage Building	Building/Structure	Water
145	Sand Pond Road - Well 1 (not active)	Building/Structure	Water
146	Sand Pond Road - Well 3	Building/Structure	Water
147	Sand Pond Road - Well 4	Building/Structure	Water
148	Sand Pond Road - Well 5	Building/Structure	Water
149	Sand Pond Road - Well 6	Building/Structure	Water
150	Water Tower (Onset Fire District)	Building/Structure	Water
151	Onset Pier Floating Shellfish Upwelling	Marine	Aquaculture
152	12th Street Boat Ramp (Onset)	Marine	Boat Ramp



**Table A-1 (continued). Town-owned assets**

#	Asset Name	Asset Type	Type Detail
153	Swifts Beach Boat Ramp	Marine	Boat Ramp
154	Tempest Knob Boat Ramp	Marine	Boat Ramp
155	Besse Park Floating Docks	Marine	Docks/Piers
156	Onset Pier Floating Docks	Marine	Docks/Piers
157	Tempest Knob Fixed Pier	Marine	Docks/Piers
158	Tempest Knob Floating Docks	Marine	Docks/Piers
159	Onset Pier	Marine	Pier
160	12th Street Boat Ramp Parking Lot	Parking Lot	Parking Lot
161	Besse Park Parking Lot	Parking Lot	Parking Lot
162	Little Harbor Beach Parking Lot	Parking Lot	Parking Lot
163	Shell Point Parking Lot	Parking Lot	Parking Lot
164	Swifts Beach Parking Lot (east)	Parking Lot	Parking Lot
165	Swifts Beach Parking Lot (west)	Parking Lot	Parking Lot
166	Tempest Knob Public Parking Lot	Parking Lot	Parking Lot
167	Hynes Baseball Field	Recreation	Baseball Field
168	Palmer Baseball Field	Recreation	Baseball Field
169	Spillane Baseball Field	Recreation	Baseball Field
170	Wareham Schools South Baseball Field	Recreation	Baseball Field
171	Ethel E. Hammond School Basketball Court	Recreation	Basketball Court
172	Hynes Basketball Court (east)	Recreation	Basketball Court
173	Hynes Basketball Court (west)	Recreation	Basketball Court
174	Swifts Beach Basketball Court	Recreation	Basketball Court
175	Wareham HS Football Field	Recreation	Football Field
176	Ethel E. Hammond School Playground	Recreation	Playground
177	Ethel E. Hammond School Playground (Swings)	Recreation	Playground
178	Hynes Field Playground	Recreation	Playground
179	Wareham Schools Soccer Field	Recreation	Soccer Field
180	Proposed Minot Forest School Soccer Fields	Recreation	Soccer Fields
181	Ethel E. Hammond School Tennis Courts	Recreation	Tennis Court
182	Wareham Schools Tennis Courts	Recreation	Tennis Courts
183	Wareham Schools Track	Recreation	Track



**Table A-2. Roads within model grid**

10th Ave	7th Ave	Arnold St	Birchwood Dr
10th St	7th St	Arrowhead Dr	Bisbee St
11th Ave	8th Ave	Arthur St	Blackmore Pond Cir
11th St	8th St	Ash St	Blackmore Pond Rd
12th Ave	9th Ave	Atlantic Ave	Blue Jay Ter
12th St	9th St	Aunt Hannah's Ln	Blue Star Memorial Hwy
13th Ave	Acorn Ave	Ave B	Blueberry Rd
13th St	Acorn Ave E	Avenue A St	Boat Ramp
14th Ave	Acorn St	Aztec Dr	Boston Pl
15th	Adams St	Bachant Way	Bourne Cove Rd
15th Ave	Admiral Way	Back St	Bourne Hill Rd
15th St	Admirals Way	Baker Rd	Bourne Point Rd
16th Ave	Agawam Beach Rd	Bakers Island Rd	Bourne Ter
16th St	Agawam Dr	Baptiste Way	Bowler Rd
17th Ave	Agawam Rd	Barlow Ave	Boynton Ave
17th St	Agnes Ave	Barnacle Rd	Bradford Rd
18th St	Agnes St	Barnes St	Briarwood Dr
19th St	Alden Rd	Barrett Way	Bridge View Ln
1st Ave	Alfred L Gonez Ln	Bass Cove Ln	Broad St
1st St	Alfred St	Bay Point Dr	Brockton Ave
1st Way	Algelo Ave	Bay Pointe Dr	Brown St
20th St	Algonquin St	Bay St	Bruce St
21st St	Allen Ave	Bay View Ln	Brush Rd
22nd St	Almedia St	Bay Way	Bryant St
24th St	Almeida St	Bayberry Rd	Bryants Way
27th St	Ames Island Rd	Bayside Ave	Bump Ave
2nd Ave	Amos Way	Bayview St	Bungalow Ln
2nd Rd	Anchorage Dr	Beach Plum Ln	Burfield Dr
2nd St	Andrew Pt	Beach Rd	Burgee Ln
3rd Ave	Andrews St	Beach St	Burgess Point Rd
3rd Ln	Angel's Cove Way	Beaver Creek Ln	Burr Pkwy
3rd St	Anthony Way	Bedard Rd	Bush St
4th Ave	Anthony's Way	Beechwood Pl	Butler St
4th St	Anthony's Way	Belmont St	Cabral Way
5th Ave	Apache Ln	Benjamin Dr	Cahoon Rd
5th St	Apple St	Bertino St	Camarado Dr
6th Ave	Arlington Rd	Beverly Way	Camardo Dr
6th St	Arnold Rd	Birch Ave	Cameron St



**Table A-2 (continued). Roads within model grid**

Camp St	Clearwater Dr	Datewood St	Eunice Ave
Campinha Way	Cleveland Ave	David St	Everett Ave
Canedy St	Cleveland Way	David's Cross	Evergreen St
Cannonberry Way	Cliff Ave	Davis Ln	Every Ln
Cape Ave	Clifford Ave	Deane St	Fairbanks St
Captain Collis Dr	Codman Pt	Dennis Ln	Fairfield Dr
Carleton Pl	Cohasset Rd	Depot St	Fairmount Rd
Carmichael Way	Colonial Ln	Diamond Ave	Fairview Ln
Carol Rd	Columbia St	Dianne Dr	Fairway Dr
Carons Way	Commonwealth Ave	Dinahs Way	Fall St
Carter St	Connehasset Rd	Dino Rd	Fannies Ln
Cedar Ave	Coolidge Rd	Division St	Farm To Market Rd
Cedar Island Rd	Cottage St	Dogwood Ave	Farrell Ct
Cedar St	Cottage Ter	Dogwood Ln	Fathom Ln
Centennial Pl	Cottonwood Ave	Doherty St	Fearing Hill Rd
Center St	County Rd	Dots Ln	Fearing St
Central Ave	Court St	Dovekie Way	Fern Ave
Central Park Ave	Cove St	Dowd Ave	Fernande's Way
Chapel Ln	Covelli Rd	Dresden Ave	Fillmore St
Chapel St	Cowgill Ln	Driftwood Ln	Fir St
Charge Pond Rd	Crab Cove Ter	Dusty Ln	Fire Rd
Charlie Ave	Cranberry Grove Way	E Central Ave	Fishermans Cove Rd
Charlotte Memorial Dr	Cranberry Hwy	E Edgewater Dr	Flax Pond Ave
Checkerberry Ln	Crescent St	Eagle Way	Flint St
Chelsea's Way	Crocker Ave	Earl St	Florence St
Cherokee Dr	Cromesett Pt	East Ave	Forest St
Cherry St	Cromesett Rd	East Blvd	Forest Way
Chestnut St	Crooked River Rd	Eddy St	Francis St
Chipmunk Ln	Cross St	Edgewater Dr	Franconia Ave
Chippewa Dr	Curlew Way	Edgewater Exd	Frank Cutler Dr
Choctaw Dr	Cushman Rd	Edgewater Way	Frankie Ave
Chor Ave	Cw Bishop Ave	Eisenhower Rd	Franklin St
Christopher Dr	Cypress St	Eldridge Ct	Franks Way
Churbuck Ln	Daisy Ave	Elizabeth Ln	Freight House Rd
Church Ave	Dale Ave	Elizabeth St	French Ave
Circle Dr	Dangelo Rd	Ellis Ave	Fresh Meadow Dr
Circuit Ave	D'Angelo Rd	Elm St	Fresh Pond Ave
Claudia St	Daniel Rd	Elmwood St	Galavotti Ave





**Table A-2 (continued). Roads within model grid**

Gardonia St	Hathaway St	Joseph St	Lothrop Ave
Garfield Ave	Hazel Ct	Judson St	Lowell St
Gauvin St	Hazel St	Juniper St	Lucy St
Gibbs Ave	Heather Hill Rd	Kennedy Ln	Luna Ave
Gibbs Ball Park Rd	Heather Trl	Kimberly Ct	Lydias Island Rd
Gitchee Gummie Rd	Helminth Ave	Kingston Ave	Lynne Rd
Gladstone Ave	Hemlock St	Kingwood St	Madeline St
Glen Ave	Hiawatha Path	Kins Ct	Madison Ave
Glen Charlie Rd	Hiawatha Rd	Knowles Ave	Madison Rd
Glenda Ave	Higgs Rd	Kristen Ln	Madison St
Glenda St	High St	Ladd Ave	Magnolia Ave
Glendale Rd	Highland Ave	Ladner Ln	Main Ave
Glenwood Cir	Highland Bay Dr	Lake Shore Dr	Main St
Gonsalves Ave	Highland Rd	Lakeview Dr	Mallard Rd
Gordon Ave	Highland Shores Dr	Landing Way	Maple Ave
Gordon St	Highland Ter	Larch St	Maple Springs Rd
Grace Ln	Hill St	Lazy Harbor Rd	Maple St
Graham St	Hollowtree Ave	Lehi Ave	Marine Ave
Grandview Ave	Holly St	Leonard St	Marine St
Granston Way	Holly Tree Ln	Liberty Ave	Marion Rd
Grant St	Hoover Ave	Lincoln Hwy	Maritime Dr
Gray St	Hotel Rd	Lincoln St	Marks Cove Rd
Great Neck Rd	Hotel St	Linden St	Marsh Ave
Green Gate Ln	Howard St	Linwood Ave	Martin St
Green St	I- 195	Little Harbor Rd	Mason St
Greengate Ln	Independence Ln	Littleton Dr	Mason St Exd
Greenwood Ave	Indian Neck Rd	Locust Exn	Mather Dr
Grove St	Irene Ave	Locust St	Mattapoisett Rd
Groveland St	Issak St	Locust St Exd	Mattos Ave
Gull Ln	Ivy St	Long Beach Rd	Mayflower Ave
Gurney St	Jacks Marsh Ln	Long Neck Cemetery Rd	Mayflower Ridge Dr
Hammond St	Jack's Marsh Ln	Long Neck Rd	Maynard Way
Hansberry Pt	James Dr	Longfellow St	McKinley St
Harbor Ave	Jefferson Rd	Longmeadow Dr	Meade St
Harborview Ln	Jefferson Shores Rd	Longwood Ave	Meadowlark Dr
Harding St	Jefferys Path	Look Out Ln	Medina Dr
Harkins Way	John St	Loon Dr	Melwood Dr
Harrison Ave	Johnson St	Lopes Ave	Memory Ln



**Table A-2 (continued). Roads within model grid**

Merchants Way	Oakhill Rd	Pinehurst Dr	Rollins Way
Michael Dr	Oakmont Dr	Pinewood Rd	Roosevelt St
Midwest St	Ocean Ave	Pires St	Rosemary Ln
Mildred Ter	Oceanside Dr	Pleasant Ave	Rosepoint Ave
Minot Ave	Odyssey Dr	Pleasant St	Ross Ave
Mogan Way	Off Seameadow Ln	Pleasantview Rd	Roy St
Mohawk Dr	Old Beaver Dam Rd	Plover Rd	Ryder St
Monark Rd	Old Carr Lndg	Plymouth Ave	S Water St
Monroe Pkwy	Old Colony Ave	Plymouth Blvd	Sagamore St
Monroe St	Old Dana Rd	Plymouth Rd	Salt Creek Rd
Monteiro St	Old Glen Charlie Rd	Plymouth St	Salt Marsh Ln
Monument Ave	Old Onset Rd	Point Rd	Salt Works Rd
Moroni Ave	Old Town Rd	Pond St	Saltmarsh Ln
Morse Ave	Old Woods Rd	Progress Ave	Saltmeadow Dr
Morse Ter	Onset Ave	Prospect Ave	Sandalwood Ln
Moshe Ln	Onset Bay Ln	Prospect St	Sandpiper Ter
Murphy St	Osborne Ave	Pumping Station Rd	Sandusky Dr
Mya's Ct	Osprey Way	Quail Ln	Sandwich Rd
Myrtle St	Over Jordan Rd	Quasuet Ave	Sandy Rd
N Water St	Park St	Railroad Ave	Santos Dr
Nanumett St	Parker Dr	Red Brook Rd	Sariah Ln
Narrows Rd	Parkwood Dr	Redwood Park	Savary Rd
Nelson St	Partridge Path	Reed Rd	Sawyer Ct
Nephi Ave	Pearl Ave	Regent Ave	Sawyer St
Nephi Rd	Pecan St	Reynolds Ave	Sea Lavender Way
New Gravel Rd	Penny Ln	Rhododendron Dr	Sea Meadow Ln
Nicholas Dr	Pequod Ln	Riplah Ave	Sea St
Nickerson Rd	Perry Ave	River Ter	Seabreeze Dr
Nimrod Way	Peter Cooper Dr	River Way	Seahorse Ln
Nokomis Rd	Peters Way	Riverside Ave	Seameadow Ln
Norris St	Pheasant Ave	Riverside Dr	Seaview Ln
North Ave	Phillips Rd	Roberta Dr	Seawood Rd
North Blvd	Pierre Rd	Robinhood Rd	Seed St
Northport Dr	Pilgrim	Robinwood Rd	Seminole Ln
Oak St	Pilgrim Ave	Roby St	Shady Ln
Oak Ter	Pine Lake Dr	Rock Marsh Rd	Shakedown St
Oakdale Heights Ln	Pine St	Rock St	Shaker Rd
Oakdale St	Pine Tree Dr	Rodger's Rd	Shanley Way



**Table A-2 (continued). Roads within model grid**

Shaw St	Stony Point Dyke Rd	Tyler Ave	Whitman St
Shawnee Dr	Storer St	Union Ave	Whittemore Ave
Shelburne Way	Summer St	Union St	Widows Cove Ln
Shell Ln	Sunset Ave	Upham St	Wild Rose Ave
Shell Rd	Surf Ave	Upland Rd	Willard St
Sherbourne Way	Susan Rd	Upper Boundary Rd	Willow St
Sherman St	Sussex Dr	Valley Rd	Wilson St
Sherwood Rd	Suzanne Cir	Vernal St	Windsor Dr
Shore Ave	Swan Ln	Verve Ave	Windy St
Short Neck Rd	Swift Ave	View St	Winship Ave
Short St	Swifts Beach Rd	Viking Dr	Winslow Ln
Sias Point Rd	Sycamore St	W Central Ave	Winter St
Sias Pt Rd	T St	Waban Ave	Wisteria Ln
Sippican Rd	Tafrail Path	Waban Pl	Wood Rd
Skillings Rd	Taft St	Walsh Ave	Woodbridge Ave
Smith Ave	Tarpaulin Way	Walter St	Woodbury St
Sola's Cir	Tavares Ave	Wankinco Ave	Woodland Cir
Sonnys Dr	Teakwood Ave	Wankinquoah Rd	Woodland Rd
South Ave	Tern St	Wanquinguoah Rd	Woodside Ave
South Blvd	Terry Ln E	Wareham Ave	Woodville Way
Spectacle Pond Rd	Terry Ln W	Wareham Rd	Worral Ave
Spectacle Pond Ter	Thayer St	Warr Ave	Wren Ter
Spindrift Ln	Thomas Ave	Warren Point Rd	Wright Ln
Spring Ave	Thrush Ave	Washburn Ct	Wychunas Ave
Springhill Rd	Tihonet Rd	Washington Dr	Wychunas Rd
Spruce St	Tims Point Rd	Water St	Wyndmoor Run
Squaw's Path	Tinkers Ln	Waverly Pl	Zarahelma Rd
Squirrel Island Rd	Tomahawk Dr	Webster St	Zarahemla
Standish Rd	Tony's Ln	Wedgewood Pl	Zarahemla Rd
State Bog Rd	Topeka Ave	Wedgewood Way	
State St	Towhee Rd	Wellington Rd	
Station St	Town Way	Wenonah Rd	
Steep Bank Rd	Tradewinds Dr	West Blvd	
Stephen Ave	Troot Farm Rd	Western Ave	
Stephens Ave	Tuckwood Ln	Weston Ave	
Stillman Memorial Dr	Tuckwood Pl	Whippoorwill Way	
Stockton Short Cut St	Turner Ave	Whispering Pines Dr	
Stone Dr	Twin's Beach Ln	Whispering Pines Path	