# GETTING "BOATER" ALL THE TIME: MANAGING FISHING BY BOAT ON NEW YORK CITY WATER SUPPLY RESERVOIRS

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**Abstract.—**In 2003 the New York City Department of Environmental Protection Bureau of Water Supply undertook a five-year initiative to improve fishing by boat on its Water Supply reservoirs and controlled lakes in upstate New York. The project includes cleanup of administrative procedures and boat fishing areas on reservoir shores; improving two-way communication with anglers; inventorying, assessing and improving boat storage areas; and creating a long-term management plan for deep water fishing access. A focal point of the project is the development of Boat Area Rapid Assessment (BARA), an evaluation tool for establishing boat storage area carrying capacities.

## 1.0 INTRODUCTION

The New York City Department of Environmental Protection Bureau of Water Supply (DEP) is charged with ensuring a continuous supply of high-quality drinking water to nine million New York State residents. This water comes from a 2,000 square-mile up-state watershed that encompasses most of the Catskill Mountains and lands east of the Hudson River in the counties of Dutchess, Delaware, Greene, Putnam, Schoharie, Sullivan, Ulster, and Westchester. DEP owns over 120,000 acres of land in the watershed for the purpose of source water protection. These Water Supply lands are interspersed with private and public holdings, and lie within over 60 other municipalities.

Public access to some Water Supply lands for certain low-impact recreation is allowed by permit and in designated areas. Public access to Water Supply lands for recreation is established in the Water Supply Act of 1906, which requires DEP to accommodate ice fishing, shoreline fishing, and fishing by boat, and the 1997 New York City Watershed Memorandum of Agreement, which assures public access for historical hiking, fishing, and hunting on newly-purchased Water Supply lands by permit and where appropriate for public safety and water supply protection. These recreation opportunities are also provided to economically and culturally benefit watershed communities, promote appreciation and understanding of watershed conservation, and foster a land stewardship ethic among recreational users, who are often Water Supply neighbors and watershed residents (New York City Department of Environmental Protection Bureau of Water Supply 2003).

### 1.1 History

Fishing by boat on Water Supply reservoirs and lakes has been a popular activity for several decades. For many years DEP's approach to boat fishing has included permanent, on-site storage of anglers' privately-owned, non-motorized rowboats on the shore of the reservoir or controlled lake where the angler wishes to fish. On-site storage is required to reduce the possibility of contamination by substances or organisms, such as zebra mussel larvae, from other water bodies. In order to place a boat on Water Supply lands, anglers have their vessels inspected, steam-cleaned and registered at one of five DEP offices around the watershed. Areas of shoreline are designated as boat storage areas; in many cases these storage areas were created by anglers placing their boats in what they found to be desirable locations that were later designated as boat storage areas. Within these areas, anglers typically secure their boats by securing them to trees with chains or cables and locks. Boat storage and angler access near infrastructure is restricted by 500-foot no-entrance zones around intakes, dams, and similar features.

### 2.2 Current Status

In spring 2003, the Bureau of Water Supply reorganized, and management of boat fishing was assigned to a different division and reviewed. At that time, approximately 12,000 private boats were believed to be stored on the shores of all 21 controlled lakes and

reservoirs for fishing use. An accurate count of boats on Water Supply lands was difficult to obtain; enforcement of registrations had not been consistent at all locations, documentation of registrations varied between issuing offices, and records in some cases were difficult to access due to database limitations. Anglers were required to have three separate permissions to use a boat for fishing on Water Supply lands: a DEP fishing permit for the angler, a boat registration carried by the boat owner, and an annual boat validation sticker displayed on the boat.

Public complaints about fishing by boat were not excessive, but some issues raised by anglers and neighboring property owners were recurrent. These included boat crowding, trash in boat storage areas, unused boats blocking desirable storage spots, poor enforcement of registration and use rules, and unsightliness (New York City Department of Environmental Protection Bureau of Water Supply 2004)

Review of boat storage areas revealed conditions of concern to water quality protection, public safety, and recreational enjoyment. Boat storage areas frequently included exposed and eroded soil, social path networks, tree mortality due to girdling and constriction from chains used to secure stored boats, and non-native invasive vegetation. Some boat storage areas were also poorly located in relation to parking opportunities, such as on the opposite side of a four-lane highway on a blind turn, with ingress to the storage area blocked by continuous vehicle guide rails.

## 2.0 IMPROVEMENT STRATEGY

In the summer of 2003 DEP developed a strategy by which to assess and improve boat fishing. Goals for this project are to meet legal commitments, integrate boat storage and use closely into the Bureau of Water Supply mission, offer outstanding deep water fishing opportunities, and minimize agency resource expenditures. The strategy includes five initiatives to be completed over five years and maintained thenceforth. These include:

1. Clean up administrative procedures and documentation, permitting, boat areas, and abandoned boats;
2. Communicate with anglers by providing interpretation and outreach, and obtaining feedback;
3. Inventory, assess, and prioritize boat storage area issues;
4. Improve and maintain boat storage areas; and
5. Finalize a long-term management plan for deep water fishing access.

The strategy and ensuing project were informed by review of other boat fishing programs, especially on the Saltonstall Reservoir of the New Haven, Connecticut, water supply (Interview and site visit: Kate Powell, November 2002), and feedback from reservoir boat anglers. Observation of boat fishing administration, management, and storage area conditions, and the results of a Boat Working Group composed of DEP land management, water quality control, engineering, and police staff which met in May 2003 also helped develop the project approach.

## 2.0. CLEAN UP

From 2003 to 2005 cleanup of administration methods and boat storage areas were priorities. Boat registration databases were improved by removing errors and duplicates. They were then subsumed into the centralized database used for all other land management and recreation activities. This allowed boat fishing information to be linked to other Water Supply land activities, such as property inspections, hunting, hiking, and maintenance projects. Database processes for boat registration and management were developed, and the system made available at all offices involved in boat fishing. This helped assure consistent administration and documentation from office to office, as well as database integrity. It also allowed for more customer-friendly fishing; a permit formerly required of anglers became unnecessary and was eliminated, and boat registrations were extended to two-year duration rather than one. Centralization also reduced resources required for boat administration, freeing up local office staff for other duties.

In the field, nearly 5,000 unseaworthy and unregistered boats were removed or updated by their owners. The first

"reservoir cleanups" were also held; volunteers assisted staff with trash removal from reservoir lands. These are now an annual event with at least one reservoir cleanup scheduled for each reservoir and lake in the warmer months. Attendance in the 2005 season was over 220 participants at 20 locations with over 20 truck-loads of trash removed.

## 2.1.Communication

Also beginning in 2003, improved communications with boat anglers was recognized as a priority. Many anglers seemed unaware of registration obligations, responsible land use methods, and land managers' desire for angler feedback. To address this deficit, part of the biannual newsletter *Watershed Recreation* was dedicated to boat angler news. Registration renewal applications were also mailed directly to the boat owners before expiration to encourage compliance, and renewal applications included a boat owner survey to obtain information on boat use, program satisfaction, and improvement ideas. An e-mail address was created for direct communication on recreation-related comments and questions, and now handles an average of over 400 emails per month, which are regularly reviewed. Staff also reached out to some key stakeholders, such as sporting clubs and advisory groups, for feedback and ideas.

## 2.2.Inventory and Assessment

A baseline inventory and assessment of boat storage areas began in 2004. This was the first comprehensive review of boat area conditions to be conducted. Goals were to: 1) rapidly inventory significant characteristics in existing boat areas, 2) identify which boat areas could be improved or should be phased out of use, 3) determine boat storage carrying capacities, 4) retain some boat storage capacity on each reservoir and 5) develop initial boat area management criteria. As a first step, all boat areas were mapped using Global Positioning Systems technology and represented with Geographic Information Systems (GIS) software in the land management database, geo-referenced to City property. A method was then developed to help achieve these goals. This method is called *Boat Area Rapid Assessment* (BARA).

### 2.3.1 Boat Area Rapid Assessment

BARA is a systematic tool for inventorying boat storage areas and using the data to determine boat storage area carrying capacity. An existing boat storage area assessment tool suitable or adaptable to DEP's needs was initially sought. On-site storage of non-motorized row boats for purposes of angling and excluding general recreational use with a steam-cleaning requirement and on an unfiltered water supply appear to make the DEP situation somewhat unique, however, and no suitable model was found. BARA was therefore developed based upon staff experience with and observation of DEP boat storage areas and boat use, the limits of acceptable change (Stankey et al. 1985) and visitor impact management (Graefe et al. 1990) approaches, input from an academic authority on conservation area recreation (Interviews and site visit: R. M. Schuster, May 2004), and "trial and error" on some boat storage areas East of Hudson, where angler use is highest.

The first step in creating BARA was to identify the characteristics of boat storage areas that are important to inventory and could be used to determine boat storage capacity. Twelve characteristics were selected. These criteria are:

- **Access safety**—Can recreational users get to the boat storage area from parking in relative safety? This was evaluated by giving each parking access a number score. One point was deducted for more than two lanes of traffic and one for poor line of sight, or the inability to see oncoming traffic at a distance great enough to allow sufficient reaction time. Parking areas on the opposite road side from the boat storage area lost 2 points, and 0.5 was deducted for every 10 miles per hour of speed limit over 35 miles per hour. Boat storage areas for which the main parking access received a score of less than or equal to -3 total points were determined to be remarkable.
- **Parking capacity**—How many vehicles can park to access the boat storage area? One vehicle parking spot was considered to be 16 feet in length and wide enough to have both sets of tires

off pavement or outside the road shoulder line where lines existed.

- **Distance from parking to boat storage area—** How many feet away from parking are the stored boats? It is believed that a longer distance for anglers to walk will decrease use of a boat storage area.
- **Slope of boat storage area**—What is the average slope (%) of the storage area? A steeper average slope across a boat storage area could invite erosion directly into reservoirs and indicates accommodation of fewer boats. Slope was measured with a manual clinometer.
- **Slope of boat storage area at shoreline**—What is the slope (%) at shoreline in the storage area? Steeper shoreline slopes could be an obstacle for boaters trying to move their boats from storage to water and back, and is reason to accommodate fewer boats. Slope was measured with a manual clinometer.
- **Estimated extent of erosion**—What percentage of the boat storage area is estimated to be eroded due to boat storage and use of stored boats? Erosion on the shores of water supply reservoirs is a significant threat to water quality. The presence of erosion is therefore regarded as reason to limit boat storage.
- **Estimated extent of exposed soil**—What percentage of soil in the area has been denuded and exposed due to boat fishing? Exposed soil can become eroded soil more easily than vegetated soil, and is considered a limitation on boat storage capacity.
- **Tree damage**—Are 50 percent or more of the trees damaged due to fishing by boat? This included any type of impact that could be reasonably attributed to the activity of fishing by boat in the area, but most often was girdling or constriction by chains or cables wrapped around trees by boaters in order to secure their vessels.
- **Count of hitches**—How many opportunities for anglers to secure their boats exist in the boat storage area? While securing boats to trees is undesirable from a land management view, they were counted as boat hitches in this inventory for practical reasons; without trees most boat areas would have no hitching capacity. It is assumed that most anglers will not store boats in areas where they cannot secure them from theft.
- **Aesthetics**—Do boats appear crowded, is there trash, is the storage area visible from the nearest roadway, and does there appear to be 50 percent or greater wear, erosion, or vegetation loss in the storage area? These are all visible detractions from a boat storage area. This characteristic was given a numerical score; each positive response to these four factors earned a score of -1 for a possible total of -4.
- **Can a ten-foot vegetated buffer be established along the shoreline?** A minimum ten-foot wide vegetated buffer between the shoreline and stored boats is desirable to reduce direct inflow of runoff and the entrance of silt or contaminants into reservoirs. This characteristic evaluates whether or not a vegetated buffer may be established at some future time. At the time of inventory, boats in all areas were stored directly on the shore with little or no vegetated buffer present under or around boats. In some boat areas, for example, rock slabs or insufficient distance between the reservoir shore and roadway preclude the creation of a vegetated buffer, while in others, current storage of boats on the shore is the only obstacle.
- **Can the area be improved for boat storage?** This characteristic evaluates whether or not a boat area, given its limitations, is a good investment for remediation. In some cases, remediation of a boat area is not feasible, e.g., off-side parking on the blind turn of a four-lane highway or extreme steepness cannot reasonably be improved. These examples would be rated "no". An eroded storage area that can be remedied through water management techniques, for example, would receive a "yes".

Three of these variables were found to be useful for inventory, but not directly relevant to establishing carrying capacity and were omitted from that assessment.

Tree damage existed in nearly all storage areas, but in none did it exceed 50% of all trees; the measurement standard selected was not sensitive enough to capture tree impacts. Impact on trees was also observed to be unrelated to the number of boats stored in an area, rather on how anglers using the area treated the trees. It was decided that silvicultural needs on reservoir shores existed independent of boat storage and therefore should be omitted from boat area assessment, but might be used to help set reservoir maintenance priorities. Although a management concern, aesthetics was also determined to be unrelated to boat carrying capacity. Trash and vegetated screening are maintenance and management issues not necessarily related to the number of boats in the area, and wear and crowding would be adequately captured elsewhere in the assessment. Finally, the distance of the boat storage area from the primary parking opportunity, although a potentially useful descriptor, is not directly relevant to the number of boats an area should accommodate.

Several other inventory characteristics were initially considered but rejected. Measurement of soil compaction, exposure, and erosion were regarded to be too time-consuming for a rapid assessment tool. For the purpose of this project, soil compaction also seemed to be subsumed by exposed soil. A single slope measurement of each boat area was rejected as too broad to be a useful characteristic. Vegetation composition (e.g., extent and type of invasive non-native species) and trash accumulation were determined to be maintenance issues independent of boat storage area carrying capacity. The existence of guide rails between boat areas and access points was documented, but not used in boat area assessment because these can be modified as needed and, given their existence in several popular boat storage areas, are not likely a significant obstacle to access for many anglers. Finally, water depth and the quality of fisheries near the boat storage area were not included; it was assumed that over the decades anglers had selected storage locations based at least in part on these characteristics, thereby making these variables superfluous.

### 2.3.2 Establishing Carrying Capacity

BARA was used to establish each boat area's storage "carrying capacity," or maximum desirable number of stored boats, by revising a gross storage potential for each boat area in four consecutive steps according to the inventory data collected. The gross storage capacity of each area is the number of boats that could fit in each storage area regardless of all other characteristics. This value was obtained from the area of the location. The area of each storage location was calculated using GIS data. Since registered boats are 12 to 14 feet long and at least 4.5 feet wide according to DEP rules, and anglers need room to move around boats, 72 square feet were allotted for each boat.

With this quantity of boats as a starting point, inventory data are systematically used site by site to create a final boat storage carrying capacity. This analysis is in four sequential steps: 1) assess for elimination criteria, 2) establish an initial boat carrying capacity based on usable land area and hitching opportunities, 3) incorporate natural resource characteristics, and 4) recognize parking limitations.

**1) Assess Elimination Criteria**

Each boat storage area is assessed in regards to access safety and whether or not the opportunity to develop a vegetated shoreline buffer free of boats exists. These are the first characteristics considered because they are not realistically mutable and are regarded to be of primary importance to visitor safety and water supply protection. In this step, areas scoring less than -3 for access safety or given a "no" for the vegetated buffer characteristic are eliminated; they are closed for purposes of any new boat storage and are given a carrying capacity of zero boats. Boat areas given a carrying capacity of zero (K=0) in this step are not evaluated in steps two through four.

**2) Establish Initial Boat Carrying Capacity**

For each boat area not eliminated in Step 1, the area required for the ten-foot wide vegetated buffer (10* shoreline length) is deducted from the total boat storage area to describe the boat storage area that would be available with a vegetated buffer in place. The total estimated hitches in this revised boat storage area are calculated by deducting the estimated number

**Table 1.—Reduction in boat area carrying capacity according to erosion level**

| Percentage of Boat Storage Area Eroded | Number of Boats Deducted from Ki |
|---|---|
| 0 - 10 % | -0 |
| 11 - 15 % | -20 |
| 16 - 20 % | -40 |
| 21 - 25 % | -65 |
| 26 – 30 % | -96 |
| ≥ 31% | K= 0 |

**Table 2.—Reduction in boat carrying capacity according to amount of exposed soil**

| Percentage of Boat Storage Area with Exposed Soil | Number of Boats Deducted from $Ki_1$ |
|---|---|
| 0 - 10 % | -0 |
| 11 – 20% | -20 |
| 21 – 30 % | -40 |
| 31 – 40 % | -80 |
| ≥ 41 % | K = 0 |

of hitches in the vegetated buffer, where no boats will be stored, from the total count of hitches. The estimated number of hitches in the vegetated buffer is derived by finding the average number of square feet per hitch in the boat storage area, then using this average to deduct the number of hitches that would be in the vegetated buffer. The remaining number of hitches is multiplied by two, since each hitch can accommodate two boats, to obtain a number of boats – an initial carrying capacity (Ki) - that can be stored in the area.

**3) Incorporate Natural Resource Conditions**

Three steps pertain to the natural resource conditions of the boat storage area. One step addresses erosion, one exposed soils, and one slope. The presence of erosion, exposed soils, and steep slopes in a boat storage area will reduce the boat carrying capacity of the area. For each characteristic, the amount by which the boat carrying capacity is reduced at each natural resource impact level was determined by observation and trial and error; while a number of boats may need to be limited in some areas due to natural resource conditions, boat storage opportunities for anglers could not be severely curtailed.

For erosion, a certain amount of boat storage capacity is deducted from Ki at each estimated level of erosion. As erosion increases, the number of boats deducted increases with extensive erosion, yielding a carrying capacity of zero (Table 1). The result of this assessment is the new carrying capacity, a number of boats $Ki_1$.

The presence of exposed soils is treated similarly, with the new $Ki_1$, after erosion reductions, being further modified to reflect conditions regarding exposed soils. The more estimated exposed soil in the storage area, the more boat carrying capacity is reduced (Table 2). The results of this assessment step is the new carrying capacity, a number of boats $Ki_2$.

Slope of the boat storage area is again treated similarly, with the new $Ki_2$, after exposed soils deductions, further modified to reflect the slope of the storage area. The greater the slope of a storage area, the more boat carrying capacity is reduced (Table 3). Where average slope across the boat area equals or exceeds the slope at shoreline, the deduction in boat carrying capacity is proportionately greater than in situations where the shoreline slope exceeds the average slope across the whole storage area. This is because

**Table 3.—Reduction in boat carrying capacity according to storage area slope**

| Slope in percent, where % slope at shoreline > average slope of boat storage areas | Number of Boats Deducted from $Ki_2$ |
|---|---|
| 1 – 20 % | - 0 |
| 21 – 30 % | -30 |
| 31 – 40 % | - 60 |
| ≥ 41 % | - 120 |
| **Slope in percent, where % slope at shoreline ≥ average % slope of area** | **Number of Boats Deducted from $Ki_2$** |
| 0 – 15 % | - 0 |
| 16 – 20 % | - 10 |
| 21 – 25 % | - 30 |
| 26 – 30 % | - 60 |
| ≥ 31 % | - 120 |

greater shoreline slope is regarded to be self-selecting, with fewer anglers willing to maneuver their vessels in and out at a steep shoreline, and this requires less capacity reduction. Also, the potential threat of erosion from steeper slopes across the whole boat area is possibly more significant than a steep shoreline. The result of this assessment step is the new carrying capacity for the boat area, a number of boats $Ki_3$.

**4) Recognize Parking Limitations**

The boat area carrying capacity $Ki_3$ is now assessed in terms of parking availability. A minimum of 10 boats per parking space was selected as the per boat parking ratio based on existing boat/parking space ratios, and staff observations that relatively few boats were ever simultaneously in use, even on the busiest fishing days. Where $Ki_3$ exceeds parking, the carrying capacity is reduced to create a storage capacity of no more than 10 boats per parking space. This is intended to assure adequate parking for each boat storage area at maximum use.

## 2.4 Improve, Maintain, and Close Boat Storage Areas

By late 2005, certain boat storage areas that had been assessed with BARA could be maintained according to the established carrying capacities, and prioritized for improvement or eventual closing. Carrying capacities were established for most of the East of Hudson boat storage areas. Each was documented in the land management database and linked to the boat storage area so that staff can register boats for specific locations according to storage availability. The database tracks total carrying capacity for each area as well as current availability. The database also notes what characteristics of those evaluated present challenges at each boat storage area in anticipation of re-evaluation and the opportunity to undertake improvements.

Improvements to boat storage areas are currently undertaken as opportunities arise. In one instance, a storm water management project in early 2005 near a boat area also encompassed installing metal hitching posts and a gravel access apron at the shore in the boat storage area according to a site plan. This improvement could reduce shoreline impacts by steering traffic in and out of the water to a single, improved access point, encouraging the establishment of a vegetated buffer elsewhere on the shore, and providing structures for securing boats other than trees.

Storage areas that were identified in BARA as remarkable due to safe access issues and no opportunity to develop vegetated shoreline buffers are priorities for elimination. Anglers have stored their boats in the same areas for years and are attached to them, however, and on several reservoirs adequate additional storage for the boats that would have to be moved from these areas is not currently

available. For these reasons, storage areas that did not pass Step 1 of BARA are closed to new boat storage. It is anticipated that most will be eliminated by attrition as anglers remove boats on their own. Once new storage opportunities can be identified, anglers may be asked to move their boats from these areas.

### 2.5 Management Plan

Developing a management plan for fishing by boat is the final stage of the strategy. A primary part of the final management plan will be to integrate use of the database and inventory characteristics into regular inspection and maintenance of boat storage areas. Maintenance of boat storage areas currently includes only inspection of boat registrations with no attention to land or recreation resource conditions. The inventory effectively provides a baseline of boat storage area conditions; these should be monitored and remediation undertaken as needed, including changing boat storage carrying capacities as indicated by changes in inventory characteristics and improvement work in boat areas. The management plan should also describe the means to close and create new boat areas. The boat management plan should be integrated into land management at the reservoir level, coordinating boat fishing with other recreational uses (i.e., hunting), forest management, and property maintenance, and be related to recreational use levels and patterns, and user demographics, in the watershed community context.

## 3.0 RESULTS

Currently nearly 9,000 people own 11,400 boats on Water Supply lands, out of a total 97,000 estimated recreational users of City Water Supply property. Of the total 250 boat storage areas, 178 have been inventoried using BARA. These are all on Water Supply reservoirs and controlled lakes east of the Hudson River. Carrying capacities have been implemented for 150 of the assessed boat storage areas. Sixty-eight of these are closed to new boat storage, and one has been substantially improved. In the third year of the five-year initiative, steps one and two of the improvement strategy - cleanup and communication - are complete and the results are being actively maintained. Inventory is 71 percent complete, and assessment 60 percent. Improvement of boat areas is 10 percent complete and creation of a final boat management plan 20 percent; improvement of individual boat storage areas is expected to be gradual over several years as resources can be made available. Alternative means of providing deep water fishing access, such as fishing piers or providing boats for general public use, have been raised as a result of this project. A brief draft plan for boat management has been created. In 2006, data collection and assessment is scheduled to continue on the West of Hudson reservoirs as is reconvening the Boat Management Working Group to review what has been done to date.

## 4.0 DISCUSSION

A main point of interest in this project is the selection and use of the boat area inventory characteristics. Conducting the inventory on reservoirs west of the Hudson River may show that the inventory characteristics and their value in calculating carrying capacity may need modification; shorelines are generally steeper West of Hudson, angler use of boat storage areas more diffuse, distances from parking to boat storage areas longer, and boat storage areas larger with fewer boats.

It would be interesting to use the inventory characteristics to describe what makes a good boat storage area from the anglers' point of view. Since current boat storage areas were largely created by the anglers themselves, it would be informative to analyze boat area characteristics for their predictive potential –can we determine from the existing boat areas what characteristics of boat storage areas are most important to anglers? How are they weighted relative to each other? For example, is a short distance from parking to the storage area more important than the steeper slope of the area to the angler? Location of good fisheries, deep water, and other characteristics would likely need to be included in such an analysis. This analysis would help improve existing boat storage areas and create better new ones.

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