

Beach Replenishment



BEACH REPLENISHMENT: WHO BENEFITS, WHO PAYS, WHO SHOULD PAY?

Beaches always have been important to the region. In 2007, we will mark the 400-year anniversary of the first landing on the beach at Cape Henry and the subsequent establishment of the first permanent English colony in North America at Jamestown.

Our beaches serve us in multiple ways. To some, they are residences; to others, beaches are places to engage in recreation, or locations for military bases, or sites for business and port activities.

However, beaches also serve ecological and natural purposes and host a variety of animals, fish and fowl. Coastal ecosystems (micro-organisms, worms, crabs, birds, turtles and the like) also benefit from wide, clean beaches and non-polluted, adjacent waters.

One of the most important ecological and natural functions of wide, sandy beaches is to reduce the power of the waves in hurricanes and northeasters. Reduced wave power in turn diminishes the damage inflicted on shore buildings, roads and other marks of civilization.

Though Virginia boasts more than 5,000 miles of shoreline, including the Chesapeake Bay, it has only 29.14 miles of public beaches. Hampton Roads claims 89 percent of those beaches (26 miles) and most of this beach frontage is in the city of Virginia Beach.

The natural pounding of the ocean redistributes beach sand from one location to another. Storms and hurricanes accentuate this movement. Thus, one beach will disappear even as another forms. Willoughby Spit, for example, is the product of a series of storms and hurricanes that hit Norfolk between 1799 and 1807. More recently, in 2003, Hurricane Isabel depleted the sand on the Spit and the city of Norfolk subsequently spent \$3.8 million to place 428,000 cubic feet of new sand there.



The redistribution of sand by waves and wind is a never-ending process, and shifting has been augmented by a slow, but steady rise in the sea level within Hampton Roads. Since the colonists arrived in the early 1600s, the sea level has increased 5.8 feet.

Thus, a variety of natural forces causes many beaches to reshape themselves or even disappear over time. In many parts of the world, little attention is paid to this age-old phenomenon. Such is not the situation in Hampton Roads, however, where beaches are extremely valuable assets that provide residences for tens of thousands of people and serve as the locus of the region's thriving tourist industry. If a beach becomes smaller, or even disappears, this adversely impacts the economic welfare and livelihoods of numerous people.

In 2005, according to Old Dominion University economists Vinod Agarwal and Gilbert Yochum, tourists who visited the city of Virginia Beach spent \$838 million on or near its beaches. This is the catalyst for significant physical economic development. The assessed value of real estate in 2006 of the four areas of the city usually considered to be beach locales – Croatan, Ocean Beach Park, Oceanfront and Sandbridge – was slightly more than \$4 billion, according to Paul Schirle, systems analyst for the city's Center for Geospatial Information Services.

It is no surprise, therefore, that maintaining or improving beaches by means of sand replenishment is a major interest of several cities in our region, but especially Virginia Beach. However, beach replenishment can be pricey, with the cost of replacing sand on beaches in developed areas ranging from \$3 million to \$20 million per mile. More than \$150 million was spent in the region on beach replenishment between 1996 and 2003. About two-thirds of that cost was borne by the federal government.

Beach replenishment is not a one-time effort; maintenance is required. A beach is analogous to road and bridge infrastructure that must be maintained and upgraded. The size of the expenditures associated with beach replenishment naturally leads us to a series of questions:

1. How well does beach replenishment work?
2. Who benefits from beach replenishment?
3. Who pays for beach replenishment?
4. Does beach replenishment harm the environment?
5. In light of the benefits and costs, who should pay for beach replenishment?

We provide answers to these questions in the sections that follow.

DOES BEACH REPLENISHMENT WORK?

The success (or failure) of beach replenishment typically is judged in economic terms. The costs of beach nourishment ordinarily are easy to ascertain, though on occasion there are spinoff environmental costs that are ignored. The major benefits are four-fold:

- Appealing beaches attract residents and tourists, whose increased enjoyment is difficult to quantify, but nonetheless real.
- Attractive beaches entice tourists who spend money and pay taxes.
- Property values on and near beaches increase; this benefits both the owners and localities.
- Infrastructure on or near beaches is less susceptible to storm damage.

Let's examine each of these in turn to help us assess whether beach replenishment works.

A ROUGH APPROXIMATION OF THE CONSUMPTION VALUE OF BEACHES TO THE CITIZENS OF VIRGINIA BEACH

Economists are famous for paying comparatively little attention to what people say they prefer, but instead concentrating on how they actually behave. In the context of beaches, this means that while we acknowledge that people say they enjoy beaches and value them, we will not pay much attention unless their actual behavior demonstrates this.

If people value beaches, then they should be willing to pay higher prices for housing near beaches and willing to accept lower wages (holding other things constant) in order to lead a “beach life.” These are testable propositions and Glenn Bloomquist, Mark Berger and John Hoehn did so in the American Economic Review in March 1988. They found that people who lived in a county that contained an ocean beach were willing to pay higher prices for housing, and willing to accept lower wage rates, in order to live there. In 1988 prices, they computed the value of this inclination to be \$467.72 per household annually.

Updating this to 2006 gives us an annual value of \$1,100 per household. Approximately 160,000 households exist in Virginia Beach, so a rough approximation of the consumption value of Virginia Beach’s beaches to its citizens is $160,000 \times \$1,100 = \176 million. This is \$400 per citizen in 2006 prices. Per capita income in the city was about \$35,000 in 2006. Therefore, our rough-and-ready estimate of the implicit consumption value of the resort city’s beaches to its citizens is $\$400/\$35,000 = 1.14$ percent of their incomes. This is substantial.

When sand on ocean beaches is replenished, it makes those beaches more attractive; without sand replenishment, the same beaches would still be attractive, but less so. What proportion of the \$176 million consumption beach value just computed would remain if the beaches were not replenished? We cannot provide a precise answer to this question, but can observe that oceanfront property without a sandy beach still has considerable value. Several local real estate agents suggested to us that about one-half of the value of traditional Virginia Beach oceanfront property would remain even if much of the sand disappeared from those beaches.

Let’s assume these Realtors are in the ballpark with their estimate that half of the value of oceanfront property in Virginia Beach is due to beach replenishment. **Then, we can approximate the consumption value of replenishing these beaches to the citizens of Virginia Beach at \$88 million annually. Other benefits, for example, the reduction of storm damage because of beach replenishment, are additional. Needless to say, this dwarfs the average annual cost of beach replenishment to all parties, which averages about \$15 million annually.** Thus, beach replenishment clearly pays off for Virginia Beach even though it probably is true that some citizens benefit far more than others. Those who live on or near the beach, and those who patronize the beaches frequently, are the biggest gainers, but every citizen benefits somewhat.

REGIONAL TOURISM

Since 1951, the city of Virginia Beach has replenished portions of its “resort beach” (which runs south from 43rd Street to Rudee Inlet) every year. Recently, this has involved importing about 400,000 cubic yards of sand annually to counteract long-term erosion.

The economic impact of tourism is very significant to the economy of Hampton Roads. Professors Agarwal and Yochum of ODU’s Department of Economics have for many years estimated the economic impact of tourism for the city of Virginia Beach. Table 1 summarizes trends in taxes paid by tourists who have visited Virginia Beach over the past six years. Between 2000 and 2005, the number of nights hotel rooms were occupied grew by approximately 6 percent, while the tax revenues derived from these hotel rooms increased almost 40

Year	Hotel Room Nights	Tax Revenues (millions)
2000	2,026,249	\$50.5
2001	1,972,465	\$53.6
2002	2,062,202	\$62.3
2003	2,143,120	\$65.6
2004	2,124,642	\$68.8
2005	2,143,221	\$70.5

Sources: Virginia Beach Tourism Economic Impact Study, Old Dominion University Economic Forecasting Project, and Tourism Economic Indicators Report of the City of Virginia Beach (various years)

percent. Among other things, these numbers reflect a gradual, but distinct movement in the direction of upscale tourism in Virginia Beach.

Repeat visitors to our beaches are economically important because they provide a dependable stream of spending to the local economy. In theory, beaches that have been replenished with sand should attract more repeat visitors. Table 2 depicts a weak, but positive relationship (though not statistically significant) between beach nourishment one year and the percentage of visitors the next year who were repeat visitors. While hardly conclusive, these data provide at least a basis for the argument that beach replenishment makes an eventual difference with some tourists.

PROPERTY VALUES AND TAXES

Waterfront property nearly always is valued more highly than nearby land with no waterfront. The Bloomquist-Berger-Hoehn study cited above captures some of this. Property values in areas on or within several blocks of the Atlantic Ocean in Virginia Beach appear to be about 25 percent higher than comparable properties located elsewhere in the city. The assessed value of real estate in the four neighborhoods commonly considered oceanfront was \$4.02 billion in 2006 (this was about 9 percent of the aggregate assessed valuation within the city).¹ Though the 25 percent premium is a ballpark estimate, it suggests that in the

absence of oceanfront with wide, sandy beaches, the assessed value of these properties would have been \$3.2 billion. As above, let's assume that one-half of the \$800 million premium can be attributed to beach replenishment. This means the increase in assessed valuation due to beach replenishment is approximately \$400 million.

Private individuals and businesses that have experienced the estimated \$400 million increase in the assessed valuation of their property no doubt are grateful, but for them this is a two-edged sword. Higher assessed valuations mean higher real estate tax payments. In 2006, Virginia Beach's real estate tax rate is \$.99 per \$1,000 of assessed value. Hence, these property owners will pay an additional \$3.96 million (which we will round to \$4 million) in taxes to the city as a consequence. While this additional tax obligation will inflict pain on the property owners, they will recoup some of that expenditure by means of additional services the city of Virginia Beach supplies. Further, they always have the option of selling their property and, as one property owner put it, "taking our money and run."

Note carefully that this analysis is based upon two critical assumptions. First, we have assumed a 25 percent ocean neighborhood real estate price premium. Second, we have assumed only half of this premium is due to beach replenishment. To the extent these values differ from reality, then our estimates of a \$400 million increase in property values and \$4 million in additional annual real estate tax payments change.

REDUCED STORM DAMAGE

Our region's proximity to the Atlantic Ocean makes it vulnerable to coastal storms that cause damage by flooding, waves and erosion. Sandy beaches typically respond to storm conditions by changing their profile to sandbars under water that break the waves further offshore. In general, the wider the beach, the farther will be the distance from the ocean to beach structures, and hence the lower the damage that will occur to them during a storm.

¹Actual property values were higher because in recent years Virginia Beach has assessed real estate at about 76 percent of market value. This suggests that the actual market value of the oceanfront property was \$5.29 billion.

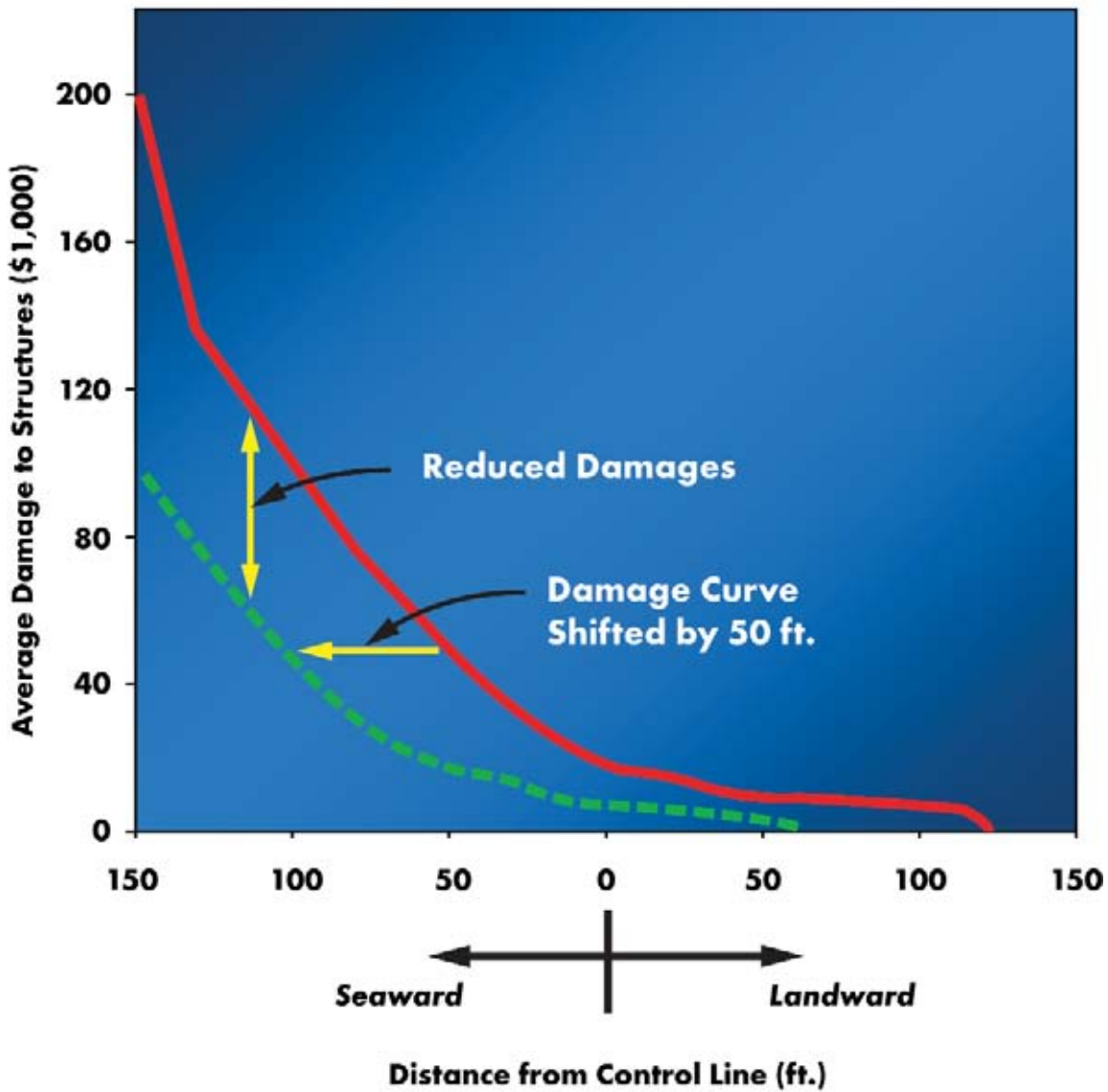
Year	Repeat Visitor Percentage	Previous Year's New Sand (cubic feet)
1994	71.8	311,790
1995	68.6	303,318
1996	69.4	289,450
1997	75.0	300,000
1998	72.7	3,200,000
1999	75.8	4,000,000
2000	73.6	0
2001	73.0	0
2002	78.0	3,200,000
2003	78.2	4,000,000
2004	77.6	0

Sources: Virginia Beach Tourism Economic Impact Study, Old Dominion University Economic Forecasting Project and U.S. Army Corps of Engineers

The textbook example in this regard is Hurricane Eloise (1975) in Florida, whose storm damages are illustrated in Graph 1. The red curve depicts actual damages (thousands of dollars) to 540 structures relative to their distance in feet from the ocean. The green curve represents the reduction in damages that a 50-foot-wide beach nourishment project would produce. The difference is easily observable.

In 2002, "Operation Big Beach" was completed to widen the Virginia Beach oceanfront 300 feet as part of the Beach Erosion Control and Hurricane Protection Project. This was a joint effort between the U.S. Army Corps of Engineers and the city of Virginia Beach. Figure 1 (dated summer 2002) shows beach width being increased by mining 3.5 million cubic yards of sand offshore and then placing it on beaches ranging from 89th Street in the north to Rudee Inlet in the south.

**GRAPH 1
HURRICANE DAMAGE TO STRUCTURES
COMPARED TO DISTANCE FROM THE OCEAN**



Source: Hurricane Eloise (1975), adapted from Dean, 1988.

FIGURE 1



City of Virginia Beach “resort beach” under construction to 300-ft width at 40th Street in summer 2002. The entire project included a new seawall/boardwalk system, wider dunes on the north end and storm water drainage pump station, as well as a new, wide beach from Rudee Inlet to 89th Street (6 miles), requiring about 3.5 million cubic yards of sand obtained offshore.

Sandbridge Beach, located in southern Virginia Beach, currently is the site of a joint beach nourishment project between the city of Virginia Beach and the Corps of Engineers. Sand replenishment took place here in 1998 and again in 2003, when 2 million cubic yards of sand widened the beach 100 feet to 150 feet over almost five miles of oceanfront. This beach replenishment made a big difference when Hurricane Isabel hit in September 2003. Graph 2 displays the estimated annual damages due to flooding at Sandbridge without a wider beach (indicated in red) and with the 2003 nourishment project (indicated in green). However, note that when very strong storms hit, even a wider beach will not prevent flood damage.

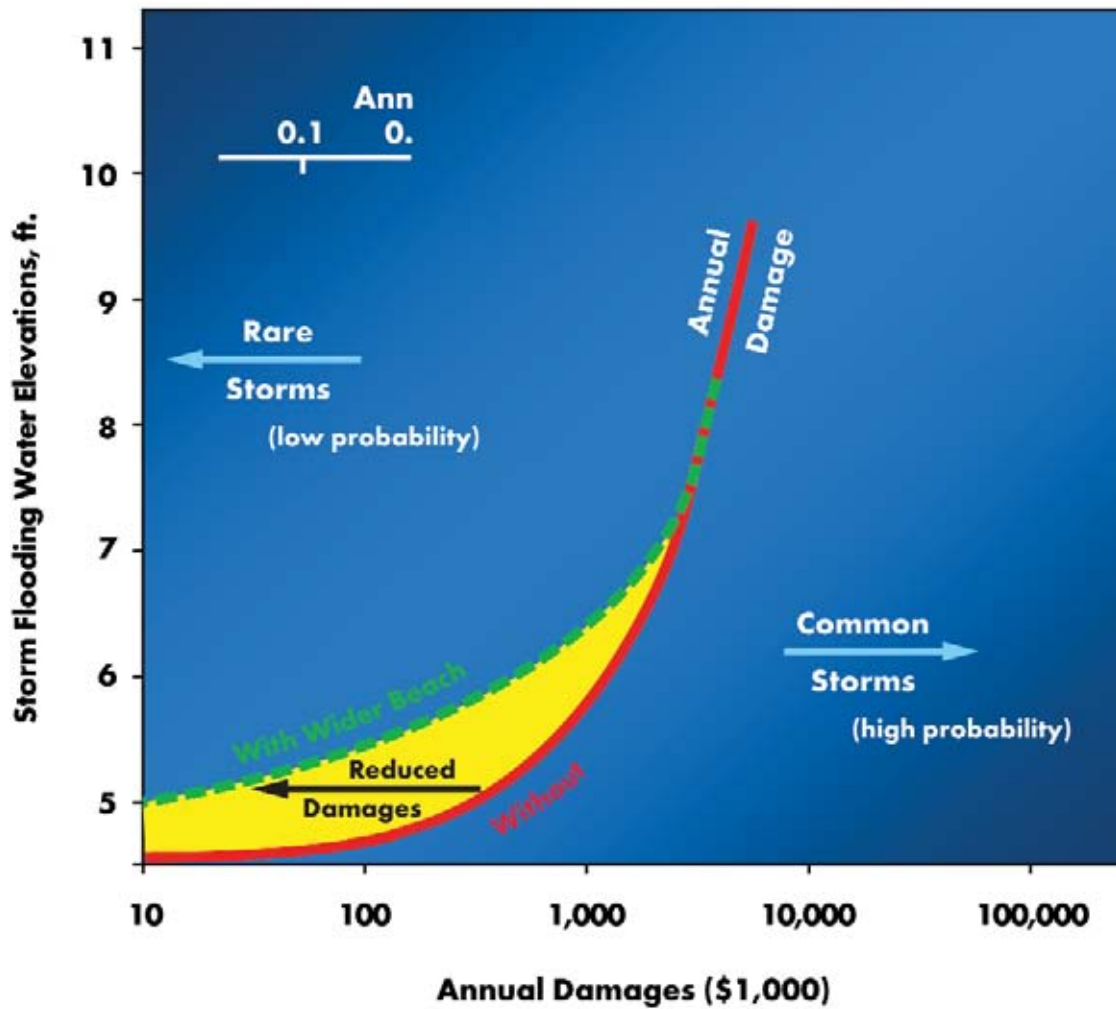
Hurricane Isabel (Sept. 18, 2003) provided a severe test for the beaches of Hampton Roads. Flood levels were the second highest ever recorded and only 1.6 inches below the record set in August 1933. Isabel occurred during a time of relatively low tides. Otherwise, it would have established the region’s all-time record for flooding.

The Corps of Engineers conducted post-Isabel damage surveys and estimated that the “resort beach” nourishment project prevented \$82 million in damages (\$52 million in residential property, \$15 million in commercial property and \$15 million in infrastructure such as roads, sewers, power, water lines and the new oceanfront boardwalk). Similar studies of Sandbridge found \$23 million in damage prevention by the beach nourishments in 1998 and 2003.

The U.S. Navy Dam Neck facility also benefited from the 1996 nourishment project. More than \$18 million in potential Isabel damage was avoided to multistory housing facilities and the 16-inch gunnery range at the oceanfront. This is an average of \$2.3 million per year over the eight-year period of beach replenishment.

Storm damage reduction benefits from beach replenishment during Hurricane Isabel totaled \$131 million, according to the Corps of Engineers, and are summarized in Table 3.

**GRAPH 2
DAMAGE TO STRUCTURES IN SANDBRIDGE GIVEN
VARIOUS LEVELS OF WATER DEPOSITED BY HURRICANES**



Source: Norfolk District, Corps of Engineers, Reevaluation Report, April 1996

TABLE 3

**BEACH NOURISHMENT COSTS PRIOR TO HURRICANE ISABEL (SEPT. 18, 2003)
AND ESTIMATED STORM DAMAGES AVOIDED DURING ISABEL**

Location	Nourishment Costs 1996 Through September 2003	Estimated Storm Damages Avoided During Hurricane Isabel
Virginia Beach (Oceanfront) (Sandbridge)	\$125.0 million \$ 10.0 million	\$ 82.0 million \$ 23.0 million
Norfolk (Ocean Park)	\$ 6.0 million	\$ 5.0 million
Hampton (Buckroe)	\$ 4.0 million	\$ 3.0 million
U.S. Navy (Dam Neck)	\$ 7.5 million	\$ 18.0 million
Totals	\$152.5 million	\$131.0 million

Source: U.S. Army Corps of Engineers

ENVIRONMENTAL CONSIDERATIONS

Beach nourishment is potentially harmful to the ecosystems at the replenishment site, at the area where the sand is borrowed and at adjacent beaches. Environmentally oriented organizations such as the Sierra Club and the national Public Interest Research Group (PIRG) frequently oppose beach replenishment. As the PIRG put it, “the pumping of sand for beach ‘nourishment’ or ‘replenishment’ actually works counter to beach health by damaging natural beach functions that are critical for plants, wildlife, and storm protection.” (U.S. PIRG, Southern Office, May 8, 2003)

The food chain on a beach begins with the tiniest organisms living in the spaces between the sand grains and includes the worms, crabs, sea turtles, marine mammals, fishes, shore birds and the physical habitat (plants and grasses) that comprise the ecological system. Because many beaches are nourished by pumping sand from offshore resources by dredges, these operations may create turbidity clouds, capture and kill turtles, and modify the underwater and on-land habitats in both diversity and numbers of species normally living at the coast.

Some of these effects are short-lived and perhaps not harmful to the local environment. For example, extremely fine-grained sediments make up only a small fraction of the borrow material in Hampton Roads; the resulting turbidity during dredging is low; and no living coral reefs exist nearby to be smothered by this action.

A joint permitting process (the U.S. Army Corps of Engineers, Virginia Institute of Marine Science and the various regional wetlands boards) attempts to scrutinize all beach nourishment projects within Hampton Roads for possible harm to the environment. Within Hampton Roads, there are four species of turtles (Kemp’s ridley, leatherback, hawksbill and green) that are included on the National Marine Fish Service list of endangered species. To minimize adverse impacts, intense monitoring of turtle nesting places is required when beach replenishment takes place, and sand dredges must have protective devices to avoid trapping turtles. It is not yet clear whether either the concerns or the efforts to deal with them are significant.

Still, a beach ecosystem consists of far more than turtles and we don’t yet know precisely how beach replenishment affects beach ecosystems.

WHO PAYS FOR BEACH NOURISHMENT NOW?

Currently, the costs of beach replenishment are shared. The federal government typically pays 65 percent of the costs of beach replenishment, and state and local governments pay 35 percent combined. Between 1995 and 2004, the federal government spent \$1.1 billion on beach replenishment (The Virginian-Pilot, Sept. 19, 2005) and Virginia alone received \$107 million in funding for this purpose (Surfrider Foundation, "State of the Beach 2005").

How are the lives of taxpayers in inland locations such as Peoria, Ill., or San Angelo, Texas, improved when beaches are replenished in Virginia? At first glance, the federal government's beach replenishment program appears to involve a massive redistribution of income from non-ocean beach users (easily the majority of Americans) to beach property owners, ocean towns and cities, and beach tourists. This is one of the reasons why the Public Interest Research Group has called for a reversal of the 65/35 federal versus local share of beach replenishment costs. The PIRG believes local property owners and governments benefit the most from beach replenishment and therefore should pay the largest share of the costs. The PIRG claims this would save federal taxpayers more than \$3 billion over the next few decades.

The city of Virginia Beach spent an average of \$5.5 million per year on beach replenishment during the past decade. Residents of Sandbridge pay a special add-on real estate tax to support beach replenishment. In 2005, this tax generated \$2.1 million.

BENEFITS VERSUS COSTS

Let's consider the benefits and costs that beach replenishment appears to confer on the major actors in Virginia Beach: the federal government, the Commonwealth of Virginia, private property owners and the city of Virginia Beach.

Economically speaking, the *federal government's* justification for beach replenishment logically should focus on the additional taxes it collects and the damages it avoids to its property when beach replenishment occurs. Yes, beach replenishment presumably increases the happiness of those who use the beaches, and generates economic activity, but we will evaluate those effects locally in order to avoid double counting.

With respect to additional federal tax payments that are produced by beach replenishment, it is apparent these are minimal. Ninety percent of the ocean-going tourists in Virginia Beach hail from the United States. Whatever expenditures they make in Virginia Beach would have been made anyway somewhere else in the country. **Economist Chris Colburn of Old Dominion University has approximated the additional federal tax collections generated by beach replenishment at \$944,000 annually.**

Current rules require the federal government to justify its beach replenishment contributions on the basis of the value of anticipated reductions in storm damages. Other factors, such as enjoyment, increased property values, increased tax payments and the like, may not be taken into consideration. Corps of Engineers data presented in Table 3 reveal storm damage reductions to the Dam Neck Navy Base because of beach replenishment to average \$1 million per year over the time period 1996 to 2003. No other federal installation was significantly affected by sand nourishment in Virginia Beach.

These two federal benefits amount to less than \$2 million annually, which is dramatically less than the approximately \$11 million per year the federal government has been spending on beach replenishment in Virginia Beach. This has prompted the Sierra Club to label federal funding of many beach replenishment efforts a "boondoggle" (Sierra Club, Chesapeake Chapter Newsletter Online, September-October 1998). It also explains why Presidents Bill Clinton and George W. Bush attempted to cut federal funding for such purposes.

The *Commonwealth of Virginia* similarly obtains financial benefits from beach replenishment. Analogous to the federal situation, the state benefits when it collects additional taxes from non-Virginians. It does not gain any net revenue when Virginians spend their money at the Virginia Beach oceanfront rather than, say, in Richmond or Fairfax County. It does gain revenue when non-Virginians spend money at the oceanfront. **Professor Colburn has estimated that the Commonwealth collects \$935,000**

in additional income taxes that it would not have collected anyway when beach replenishment occurs. By far, the greater impact is felt in sales taxes, where Colburn estimates that Virginia collects an additional \$23.1 million annually that it would not have collected anyway because of beach replenishment. In addition, beach replenishment has enabled state government to avert an average of \$100,000 per year in infrastructure damage to state highways and other assets. Thus, the total positive impact on state government because of beach replenishment in Virginia Beach is approximately \$24.1 million per year.

The Commonwealth contributes little to the payment of beach replenishment costs. In 1980, it created the Board on Conservation and Development of Public Beaches and established a matching grant fund to help local governments conserve and protect the 29 miles of public beaches that exist in 14 Virginia cities and counties.

Between 1980 and 1999, \$8.5 million in matching grant Commonwealth funds were allocated to local governments for their beaches. The average annual state expenditure for this purpose was about \$425,000. **Hence, the benefits the Commonwealth receives from beach replenishment in Virginia Beach are more than 50 times as large as its annual contribution for that purpose.**

Private individuals and property owners and the city of Virginia Beach reap the lion's share of the benefits from beach replenishment. To review, these benefits include the consumption value of the beaches, increased property values, increased tax collections and reduced storm damage. Let's consider each in turn.

The consumption value of beaches admittedly is difficult to quantify, but we reported the work of economists Bloomquist, Berger and Hoehn, which we updated and applied to Virginia Beach. We estimated this annual value to be \$176 million for the 440,000 citizens of Virginia Beach in 2006 and estimated that \$88 million of this was due specifically to beach replenishment.

Property values on the oceanfront, we noted earlier, appear to be about 25 percent higher than the values of comparable properties just a few blocks away. The Bloomquist-Berger-Hoehn study captures some of this. However, let's work with a hypothetical example to see what difference this makes in terms of property values and taxes.

If a non-oceanfront property is worth \$400,000, then a comparable oceanfront property will be valued at \$500,000. However, all of this \$100,000 increased value cannot be attributed to beach replenishment, since oceanfront property premiums exist nationwide even where no usable beaches exist. Hence, as we did above, we will reduce this by one-half, leaving us with \$50,000 as the beneficial contribution of beach replenishment to the value of a \$500,000 oceanfront house.

Economically speaking, the city of Virginia Beach could argue this is an unearned increment in property values and should be redistributed to taxpayers who pay for beach replenishment. That this would be politically unpopular is beyond dispute. In any case, governments almost never attempt to extract the entire amount of unearned property value increases when they undertake other value-increasing public projects, for example, new roads, schools or parks. What governments frequently do, however, is extract a small proportion of that increased value by means of property taxes. Thus, in our example above, if the value of a typical property has increased by \$100,000, and the city of Virginia Beach assesses real estate at about 76 percent of its actual market value, and the city's tax rate is approximately \$.99 per \$100 of assessed valuation, then it would increase its tax bite on this hypothetical property by \$752. This is well less than 1 percent of the increased value that has accrued because of beach replenishment.

Overall real estate assessments in Virginia Beach increased by 23 percent between 2005 and 2006, but the city has not published any data that establish that oceanfront property assessments have increased more rapidly than other property. Still, the 25 percent price premium for oceanfront neighborhood properties appears, if anything, to be a conservative estimate.

Increased tax collections due to beach replenishment accrue primarily to the Commonwealth of Virginia and to the city of Virginia Beach. We approximated the Commonwealth's tax take at \$24 million per year. Economists Agarwal and Yochum estimated that the city of Virginia Beach collected about \$70 million in sales and hotel bed taxes because of beach tourism in 2005. Perhaps 20 percent of these taxes were paid by Virginia Beach residents, leaving a net of \$56 million. These are taxes the city otherwise would not have collected.

What proportion of this \$56 million addition to tax collections is due to beach replenishment? If beaches were not replenished and allowed to deteriorate gradually, then over the years one would predict a significant falloff in oceanfront tourism, perhaps

as much as 80 percent, based upon tourism patterns at other mid-Atlantic oceanfront locations where accessible, sandy beaches are not present. Let's assume the 80 percent estimate is correct. If there were no beach replenishment for many years, then we predict the city of Virginia Beach would collect only \$11.2 million in taxes (2006 prices). Thus, it would lose approximately \$45 million in tax collections without replenishment of the resort beach sand. The city, then, has far more at stake than the state or federal governments where tax collections are concerned.

Added to this are the additional tax collections the city of Virginia Beach enjoys because of the higher property values that accrue due to beach replenishment. As noted earlier, we approximated these tax revenues at \$4 million per year.

Reduced storm damage is a significant benefit that accrues from beach replenishment. Table 3 reveals that the estimated reduction in storm damage in Virginia Beach during Hurricane Isabel because of beach replenishment was \$105 million. This was preceded by eight years of beach replenishment. Hence, over this time span, the annual average reduction in storm damage was \$105 million/8 = \$13.1 million. Updating for inflation by means of the Consumer Price Index yields a \$14.4 million average annual damage reduction estimate for 2006. Assuming the same parties would benefit from beach replenishment proportionately in 2006 and future years as they did during Hurricane Isabel, we assign \$11.6 million of these storm reduction benefits to private individuals, \$2.6 million to the city of Virginia Beach and \$.2 million to the Commonwealth of Virginia.

Against these benefits, one must consider the funds the city of Virginia Beach expends on beach replenishment (these have averaged about \$5.5 million annually). Further, the city must take into account the additional costs it incurs because it must provide public services that address the oceanfront. These include the provision and repair of streets and sewers, public safety, crowd and traffic control, plus a variety of other public services including education, libraries, public transportation and social safety net services. One Virginia Beach official has estimated the value of these services to be about \$10 million, which is no small number. Even so, the benefits of beach replenishment clearly outweigh the corresponding costs when one includes all of the various sources of benefits that accrue from beach replenishment.

SUMMING UP THE BENEFITS AND COSTS

Table 4 discloses that even though the federal government currently pays almost two-thirds of the costs of beach replenishment in Virginia Beach, it is only a minor recipient of the benefits, deriving less than \$1 million annually in tax collections and an average of about \$1 million per year in reduced storm damage to federal property. Despite these puny numbers, the federal government has spent an average of about \$13 million per year on beach replenishment in the region, of which approximately \$11 million annually appears to have been in Virginia Beach.

The Commonwealth of Virginia benefits considerably more – our estimate is \$24.1 million per year. Nevertheless, the state contributes an average of only about \$425,000 to beach replenishment.

The major beneficiaries of sand replenishment on the Virginia Beach oceanfront are the citizens of Virginia Beach. Private individuals realize benefits from: (1) their ability to utilize more attractive beaches, which we have approximated at \$88 million annually, or \$200 per capita; (2) increased property values, which we have approximated at \$400 million; and (3) reduced storm damage, which though highly variable, has averaged \$11.6 million per year in the past decade.

The city of Virginia Beach benefits from beach replenishment via: (1) increased tax receipts derived from tourist expenditures, which we estimate to be \$24 million per year; (2) an estimated \$4 million in increased tax receipts generated by the \$400 million in increased property value; and (3) diminished storm damage to its public infrastructure (our estimate here is an average of \$2.6 million per year). Over the years, the city has, one way or another, paid about 30 percent of the cost of beach replenishment. This has averaged about \$5.5 million per year, or about half of the federal government's contribution, but more than a dozen times the state's contribution.

Of course, in evaluating the wisdom of spending money on beach replenishment, the city must take into account the additional costs it incurs because of the public services it must provide to support the oceanfront. These include streets and sewers, public safety and a variety of other public services, including education, libraries, public transportation, crowd control and social safety net services. One city official puts a rough estimate of these public services in the range of \$10 million annually.

Still, all things considered, it is fair to say that beach replenishment has been a good deal, financially speaking, both for the city of Virginia Beach and the Commonwealth of Virginia. The benefits that accrue to the city, its citizens and the state clearly exceed the costs.

WHO SHOULD PAY FOR SAND REPLENISHMENT?

Table 4 summarizes our rough estimates of the annual benefits and costs associated with beach replenishment for each of the major parties involved. Costs are indicated in brackets.

Private property owners pay property taxes and, as we have seen, those local taxes capture some of the benefits they receive when beach replenishment occurs. To some extent, property taxes reflect an ability to pay. Private property owners also pay local sales taxes, plus a variety of other taxes ranging from license fees to taxes on cable television. These are user-fee taxes. Still, one can see in Table 4 that residents receive far more benefits from beach replenishment than the costs they incur for it.

Table 4 also demonstrates that the incremental benefits accruing to the city of Virginia Beach are, net of the costs of the provision of public services to the oceanfront, clearly sufficient to pay for the costs of beach replenishment. Because of beach replenishment, the city of Virginia Beach collects approximately \$45 million in additional taxes from nonresidents, an additional \$2.1 million annually from the dedicated Sandbridge tax and an additional \$4 million in annual property tax revenue, for a total of \$51.1 million in additional taxes per year.

Type of Benefit or Cost	Private Individuals	Beneficiary City of Virginia Beach	Commonwealth of Virginia	Federal Government
Consumption Value	\$ 88 m.			
Increased Property Values	\$ 400 m.			
Reductions in Storm Damage	\$ 11.5 m.	\$ 2.6 m.	\$.1 m.	\$ 1 m.
Increased Tax Revenues		\$ 4 m. higher real estate taxes		
Revenues		\$ 45 m. tax payments non-Va. tourists		.9 m.
		\$ 2.1 m. Sandbridge tax		
			\$ 24 m. sales, income tax	
Tax Payments []	[\$ 4.0 m.] [\$ 2.1 m.]			
Cost of Services Provided		[\$5.5 m.] sand replenishment		[\$11 m.]
		[\$10 m.] addtl. services provided		
			[.4 m.] state contribution	
Totals	+\$493.4 m.	+\$38.2 m.	+\$23.7 m.	-\$9.1 m.

Against this, over the past decade, Virginia Beach has spent approximately \$5.5 million per year on beach replenishment. However, replenished beaches attract more tourists and residents who require services. Let's assume Virginia Beach spends \$10 million per year in supplying law enforcement, public and social services to the oceanfront, as estimated by a city official. Setting aside the consumption value of the city's beaches, but adding in a \$2.6 million in average annual reduction in storm damage, this means that Virginia Beach earns net revenue of approximately \$38.2 million from beach replenishment. Clearly, this is sufficient to pay for the costs of nourishing the resort city's beaches with sand.

Table 4 further reveals that the federal government is the big financial loser in beach replenishment, receiving only \$.9 million in additional tax revenues and benefiting from only an average of \$1 million per year in reduced storm damage. Against this, the federal government has been spending an average of \$11 million per year on beach replenishment in Virginia Beach.

Given this distribution of benefits and costs, who should pay for beach replenishment? There are as many theories about just taxation as there are stars in the sky. One person's ideal tax is another person's nightmare. Observing this, a wag once commented, "The only good tax is one that taxes you more and me less."

Even so, many people believe that the optimal tax system should contain a mixture of taxes that addresses the relative ability to pay on the part of those being taxed (such as an income tax and perhaps property tax) and takes into account those who actually use and receive benefits from the services government is providing (gasoline taxes and tolls provide examples here).

Following this logic, since the largest beneficiaries are private property owners and the government of the city of Virginia Beach, followed by the Commonwealth of Virginia, accordingly, they should pay the majority of the freight where beach replenishment is concerned. By comparison, the benefits that accrue to the federal government are dwarfed by the costs it bears, and there is only a flimsy rationale for forcing Americans in Bemidji or Pocatello to pay for beach replenishment in Virginia.

Who actually pays oceanfront-related taxes now? In the past, the city of Virginia Beach utilized higher sales taxes to help it fund beach replenishment. This increased sales tax rate often was referred to as the "sand tax," though only some of these revenues were used to replenish beaches. In 1995, the Sandbridge Beach subdivision was established as a special property tax district to generate revenue needed to supply most of the city's share of the cost of beach replenishment projects. In 2006, the Sandbridge real estate tax rate was \$.12 per \$1,000 of assessed value (which is added to the overall city tax rate of \$.99). In addition, Virginia Beach has established a 2.5 percent tax on property rentals at Sandbridge.

Beach replenishment is especially critical to Sandbridge residents because in a typical year, 5 feet to 10 feet of that neighborhood's beach will disappear as the ocean laps at the shore. The first beach nourishment project at Sandbridge took place in the summer of 1998. During the six-year period 2000–05, assessed property values rose from \$240 million to \$605 million, an average increase of 18 percent per year. By contrast, citywide property assessments increased an average of 7.8 percent per year during the same period. Of course, these numbers are not strictly comparable because of the changing roster of properties in each area, but they do suggest rapidly rising property values in Sandbridge. Indeed, *The Virginian-Pilot* (March 1, 2006) reported that the assessed valuations of two condominium complexes in Sandbridge shot up more than 90 percent in a single year.

The special Sandbridge tax district tax generated \$2.1 million in 2005. This amount of money, received annually, would appear to be sufficient to replenish the beach at Sandbridge. It is an excellent example of a specific tax upon those who most directly benefit from the replenishment of beach sand.

Sandbridge residents apparently see things differently from the voters of Dare County, N.C., who recently voted against a 1-cent increase in their local sales tax. Media coverage focused on the feelings of voters, who argued that beach replenishment efforts benefited only a select group of wealthy absentee oceanfront property owners from other states.

Dare County includes much of North Carolina's Outer Banks and such attractions as the Cape Hatteras National Seashore and the Wright Brothers National Memorial. Funds from the tax increase were to have been used to pay for beach replenishment efforts in the county. Beaches and beach-related activities are the core of the Dare County economy. The county's permanent population is about 30,000, but increases to more than 200,000 in the summer as people flock to cities such as Duck, Kill Devil Hills and Nags Head.

Our analysis of the benefits of beach replenishment suggests these benefits are more broadly diffused among the population than Dare County voters apparently perceived. **Still, this vote underlines the sense among many citizens that those who benefit most directly from sand replenishment should pay the cost. The Sandbridge special tax district satisfies this criterion.** At the same time, if one generally accepts the principle of user fees with respect to beach replenishment, then the massive contribution of the federal government to that activity becomes even more suspect.

FINAL THOUGHTS

The good burghers of Virginia Beach and the resort city's elected officials should exult in the fact that their expenditures on beach replenishment are quite cost-effective. The benefits of beach replenishment are substantially larger than the costs of such, and this also is true for the Commonwealth of Virginia.

Harsh to say, but the apparent dupe in the beach replenishment scenario is the federal government, which has been paying 65 percent of the costs, but coming nowhere close to realizing comparable benefits. A combination of pork barrel politics and economic ignorance has produced a federal program whose primary benefits accrue to certain localities and oceanfront citizens.

Sand replenishment redistributes income from all taxpayers nationwide to those who live on or near beaches. Income redistribution may be a legitimate goal of the federal government, for example, via our progressive federal income tax. **In the case of beach replenishment, however, the beneficiaries of the income redistribution are clustered in a small number of locations nationally and often include individuals with substantial incomes. The rationale for forcing a low-income resident of a housing project in Chicago to help pay for beach replenishment in Virginia Beach is slender, and were we actually to see the exchange of money involved, it would constitute an embarrassment. We agree with the Sierra Club and others that federal funding of beach replenishment should be reduced sharply.** Note that this is not the same as arguing that the federal government should not control and guide the process; the overlapping nature of beaches among the states and the presence of federal installations on beaches militates in favor of a national approach, just not as much national funding.

Needless to say, numerous caveats exist with respect to our analysis. One is non-economic. Sand on most beaches moves continuously along shorelines as time passes. These movements recognize no political or property boundaries, property assessment rules or laws. Thus, it's not always easy to pinpoint precisely who benefits when sand is deposited in location A. As time passes, and major storms hit the beaches, sand shifts and those living in location B soon may turn out to be the real beneficiaries, while the original winners in location A may now have little or no beachfront. Nothing is permanent where the oceanfront is concerned. As a consequence, actual property values on the oceanfront can fluctuate like the shifting sands.

Further, the estimates we have provided in this chapter are exactly that – estimates. They are not precise, though they do reflect reasonable assumptions and dispassionate analysis by individuals who have no ax to grind. The results are sufficiently robust to yield several important conclusions, none of which is very sensitive to the addition or subtraction of a few million dollars here or there to reflect different assumptions. We are able to say that:

- **Beach replenishment clearly pays off for the city of Virginia Beach and its citizens. Arguably, in some combination, both should pay a greater share of the cost.**
- **The Commonwealth of Virginia benefits significantly from beach replenishment, but pays little. Arguably, it should pay a greater share of the cost.**
- **The federal government absorbs most of the cost of beach replenishment, but receives scant benefits. Only if one believes that taxpayers thousands of miles away should subsidize beach users and property owners in Virginia Beach does it make sense for the federal government to continue its massive subsidies.**





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