Case 23

Washing Away

Seaview is a small resort community on the Gulf of Mexico. Blessed with nice beaches and a good location, Seaview has grown rapidly over the last decade. The growth has not been explosive, so that Seaview has maintained a semblance of "good taste."

Seaview's city engineer, Ramon Martinez, had a number of sleepless nights during Hurricane Harvey last year. His biggest concern was a seawall that protects the first row of hotels, motels, inns, and restaurants from waves and storm tides. The seawall withstood the onslaught, but it was close. Ramon vowed to analyze the city's vulnerability along the seawall before the next hurricane season. He has gathered a first cut at the data, and it is now time to begin the analysis.

The seawall was designed to withstand a 50-year storm with an additional cushion through safety factors. Analysis has shown that Harvey was a 40-year storm for Seaview. Now after 20 years of storm damage, minor maintenance, additional data gathering, and improved design and modeling capabilities, the seawall seems to still be matched to the 50-year level. Barring destruction by a major storm, the seawall with proper maintenance and repair seems likely to last for a century or two.

During the same 20 years, the growth rate has averaged 4% annually (adjusted for inflation), rather than the 1% that was originally expected. The consequences of a large storm have increased with the rapid growth. Ramon believes that the 50-year standard is probably inadequate for the larger consequences. This inadequacy will increase as Seaview's growth is

not slowing, and the beachfront property that relies on the seawall continues to be the most prized.

Ramon has identified three types of alternatives for the city. First, future risks could be reduced by restricting development along the seawall. In an extreme version this could include condemnation of existing buildings and purchase by the city. Second, the city could mitigate the financial consequences through insurance. Seaview could require that property owners be insured for hurricane damage. Third, Seaview could increase the level of protection by strengthening the existing seawall.

Ramon plans to use an 8% interest rate in the evaluation. This is relatively high, because Seaview's rapid growth has created many needs and overstretched facilities. He is planning on using a long horizon, at least 100 years. The seawall has a long life, and the higher severity storms have even longer return intervals.

As strengthening the seawall is his "natural" reaction to the problem, Ramon started his analysis with it. The seawall is about 2.3 miles long and is located between the beach and the first row of buildings. It is readily accessible from the beach, and the strengthening project could easily be completed during the off-season.

The seawall's size and cost increase with the severity of the storm that it is designed to withstand. Strengthening the seawall from a 50-year design standard to a 100-year standard would cost $3.15 million. Each doubling of the return interval costs another $3.15 million. Rebuilding to the 50-year standard would cost $4 million, and larger seawalls would cost the same $3.15 million per increase in the design interval.

Table 23-1 summarizes the translation of return intervals into probabilities that Ramon plans to use.

Table 23-1 Probabilities for Storm Severity

Return interval	50	100	200	400	800	etc.
Inverse cumulative probability	.02	.01	.01/2	.01/4	.01/8	etc.
Probability	.01	.01/2	.01/4	.01/8	.01/16	etc.

The expected damages depend on the difference between the storm's severity and the design standard (interval) used. If the storm's severity is less than the design standard, then there is no damage. If the storm's severity matches the design interval, then damages will

equal about 10% of the protected structures' value. If the storm's intensity is one interval higher, then damage will approximate 30% of the structures' value. For two intervals higher, the damage increases to 70% of the structures' value and complete destruction of the seawall. For three intervals higher, the first row of buildings would be completely destroyed (salvage value = cost of cleanup). (See *Condominium* by John D. MacDonald). There would still be no damage to structures on the land side of Beach Boulevard, because the four-lane divided parkway and the first row of buildings will act as a bulwark.

The condemnation alternative is politically difficult at best. First, most owners would not want to sell their property. Second, the appraised value of the buildings along the beach is nearly $200 million, and they sit on land worth $60 million. Another $30 million in beachfront land has not yet been developed. This $290 million in property provides only 15% of the property tax revenue that supports Seaview's services, but Seaview cannot afford to "buy it out." It is probably easier for Seaview to acquire the $30 million in undeveloped land through condemnation proceedings than to significantly restrict the value of ensuing development if it remains in private hands. It may also be easier for Seaview to condemn undeveloped rather than developed property.

The head of the city's legal department responded positively to Ramon's query about the city's ability to require "hurricane" insurance. So Ramon conducted a small survey of building owners along the beachfront to check their insurance coverage. After the first fifteen interviews, he called the city attorney and said, "The situation is far worse than we suspected. All of the buildings are insured, but not one policy allows for failure of the seawall. In fact, six of the policies specifically disallow damage if the seawall fails." The city attorney reassured Ramon with the comment that "At least Seaview can't be sued if the seawall fails." Buying insurance to cover the damages for these extreme floods would cost 50% more than the expected level of damages. Seaview could require it and act as a central coordinator in obtaining coverage.

Ramon has asked you to prepare a report for his review, which emphasizes the economic analysis. He also encouraged you to consider the political factors that may dominate the economics. He asked you specifically to include a table summarizing the trade-offs between the four alternatives. (There are two versions of the condemnation alternative).

Option

It is nine months later, and Hurricane Clara has just destroyed Seaview's seawall and beachfront property. Clara was a 400-year storm, and the actions Ramon had suggested were still wending their way through the political process.

Disaster relief funds have been approved, but they are only covering about 60% of the loss for the private property owners. Seaview appears likely to fare somewhat better, as the governor has promised $13.5 million for a seawall designed to the 200-year standard.

The same alternatives as before exist with some modifications in their expected cost. For example, the insurance costs have gone up by a third. On the other hand, condemnation would now only require that Seaview pay for the value of the land, without the beachfront structures.