Devastating the Landscape

One day this city,
rapidly increasing as it is
in wealth and consequence,
will be swept into the Gulf of Mexico,
if the Mississippi happens to rise
[while] the south-east wind
raise the sea …

—James Edward Alexander, 1832

The Fortuitous Storm of 1722

Nature aids engineers in the initial planning of New Orleans

A few years of haphazard development following the spring 1718 founding of New Orleans inscribed an initial level of place-making into the "clean slate" of deltaic soil. One observer described the circa-1720 outpost as comprising

> about a hundred forty barracks, disposed with no great regularity, a great wooden warehouse, and … a few inconsiderable houses, scattered up and down, without any order or regularity … [they] would be esteemed common and ordinary buildings in a European village. *New Orleans*, in 1720, made a very contemptible figure.[576]

When engineers Le Blond de la Tour and Adrien de Pauger endeavored to rectify that "contemptible figure," the existing hodgepodge impeded their envisioned urban plan. Surely they would have eventually mustered official forces to clear away those first four years of unplanned cityscape, but nature beat them to it. Pauger wrote that at 2 a.m. on September 11, 1722,[577] "a great wind" swept the settlement,

> followed an hour later by the most terrible tempest and hurricane that could ever be seen …. It had overthrown at least two thirds of the houses here and those that remain are so badly damaged that it will be necessary to dismantle them. The church, the presbytère, the hospital and a small barracks building … are among [those] overthrown, without being, thanks to the Lord, a single person killed …. The river rose more than six feet and the waves were so great that it is a miracle that [all the boats] were not dashed to pieces.[578]

"With this impetuous wind came such torrents of rain," wrote Dumont years later, "that you could not step out a moment without risk of being drowned … [T]his tempest was so terrible that it rooted up the largest trees, and the birds, unable to keep up, fell in the streets. In one hour the wind had twice blown from every point of the compass." Not until 4 a.m. on the thirteenth of September did the winds abate, at which time "they set to work to repair the damage done."

New Orleans' first major hurricane proved to be a blessing in disguise. Wrote Pauger, who was responsible for surveying the new street system, "all these buildings were old and provisionally built and not a single one in the alignment of the new city and thus would have had to be demolished. Thus there would not have been any great misfortune in this disaster except that we must act to put all the people in shelter."[580] Pauger prioritized for the unimpeded execution of his street plan and the orderly development of New Orleans. He once ordered the house of a man named Traverse demolished because it violated the grid; when Traverse petitioned the city for indemnification, Pauger personally beat him repeatedly with a stick, then had him bound by the

feet in irons and imprisoned.[581]

Dumont described retrospectively the surveying of the street alignments in his *History of Louisiana*. La Tour "cleared a pretty long and wide strip [now Decatur Street] along the river, to put in execution the plan he [and Pauger] had projected." They

> traced on the ground the streets and quarters which were to form the new town, and notified all who wished building sites to present their petitions to the council. To each settler who appeared they gave a plot ten fathoms front by twenty deep [sixty by one-hundred-twenty English feet], and as each square was fifty fathoms front, it gave twelve plots in each, the middle ones being ten front by twenty-five deep. It was ordained that those who obtained these plots [must] inclose them with palisades, and leave all around a strip at least three feet wide, at the foot of which a ditch was to be dug, to serve as a drain for the river water in time of inundation.[582]

In this manner, the French swept away their own messy beginnings and imposed upon the newly emptied alluvial space a Cartesian sense of urban order. A built environment subsequently arose within the cells of Pauger's grid: the "palisade cabins" typical of Biloxi, built entirely of pine, transformed in the new New Orleans to ones built of "brick, or half-brick and half-wood," using cypress instead of pine. (Brick-between-post walls are still visible throughout the French Quarter and lower faubourgs.) Institutions of European order, both church and state, fronted the *Place d'Armes*, where once-wild nature would be controlled and aestheticized. Less than two months after the storm, "the streets of the old quarter had received the names they still bear."[583] Within several years, levees would be built by slave labor to control the river's natural flooding cycle. It was in 1722, according to Dumont, that "New Orleans began to assume the appearance of a city."[584]

A letter from a man named Devin in 1724 noted the effect of New Orleans' rise on a competing settlement: "Living in Mobile is beginning to be more disagreeable than ever. There is, so to speak, no more society." Prominent citizens, he noted, are all "going to reside at New Orleans.... There is no news here worthy of being written."[585] A short while later, Biloxi and Dauphin Island were recommended for evacuation and abandonment.[586]

New Orleans was on the rise, fortuitously assisted by the storm of 1722.

Transformation by Conflagration

The 1788 and 1794 fires and their impact on the cityscape

Densely populated, largely wooden, and nearly 300 years old, New Orleans understandably bears a lengthy history of terrible conflagrations. Two great fires within

six years during the Spanish colonial era stand out for not solely for their severity, but for the lasting transformations they occasioned upon the cityscape.

According to Spanish colonial records, at 1:30 p.m. on March 21, 1788—Good Friday—a wooden cabinet caught fire in the home of State Treasurer José Vicente Nuñez, located at Chartres and Toulouse.[587] According to Chevalier Guy de Soniat du Fossat, who recorded his memories in 1791, the

> fire was caused by the negligence of a woman who thought of crowning her devotion by making a small altar.... She left several candles burning around it and went off to take her dinner. During her absence a candle fell on some ornaments which took fire, and the house in an instant was in flames....[588]

Adjacent buildings ignited, and winds swept the flames across streets and into abutting blocks. Wood was not the only fuel for the blaze:

> The powders which the merchants had in their stores for daily use, contributed largely to accelerate the conflagration, and rendered it more dangerous to those who wanted to save the remaining buildings.[589]

By late afternoon, recorded the Spanish authorities, "4/5 of the populated section of this City was reduced to ashes, [including] the Parish Church and House, Cabildo and Jail...." Worse yet, the destroyed district comprised not the peripheral shantytowns but "the part of the City most important and best situated."[590] At least twenty square blocks centered around the Royal/Toulouse intersection were charred utterly; the "Spaniards [estimated] their loss at twenty million of *pesos*."[591] In all, 856 "fine and commodious houses valued on an average at three thousand dollars each were destroyed in that conflagration...."[592] Lost were most of the surviving French colonial era structures, noted for their raised construction, spacious galleries, and steep double pitched roofs. That such structures are rarities in the French Quarter today speaks to the ferocity of the 1788 blaze.

"It would be difficult to depict the despair of the poor unfortunate persons whose properties had suffered from the fire," continued Soniat;

> [T]hese unhappy creatures who, two hours before, enjoyed vast and commodious lodging with enough affluence to make one's life agreeable and easy, saw themselves and their children in a moment without resource. Some of them were obliged to take refuge in the woods, without necessary provisions and clothes. Some slept without cover under the broad canopy of the heavens.[593]

The disaster made news in the United States. "The misery of this place I shall not undertake to describe," wrote a New Orleanian in a letter published widely in American newspapers; "suffice it to tell you, that New-Orleans, which consisted of 1100 houses, was on Friday last, in the space of five hours reduced by conflagration to 200.... [F]ew merchandize, household furniture, or cloathing have been saved."[594]

Civic response to the disaster testifies to the common thread of humanity

bonding survivors with fellow citizens in such times. Governor Estevan Miro took action immediately after the flames died down and the sun set: he "opened his house to all who were seeking shelter … dispensed succor to the distressed families, caused the royal store, which had escaped the flames, to be opened, and … distributed the provisions there in …" [595] The Spanish Cabildo convened on Monday and issued two plans of action already under way: "first … to aid [fire victims] with daily rations of food, and to build a cottage of pickets for their urgent shelter …," and second, to allot seven thousand pesos toward the immediate repair of the jail.[596] With remarkable progressiveness, the city government then conducted a fact-finding mission "to carefully inquire through public opinion and close investigations the most essential points which must be brought to the knowledge of his Royal consideration …."[597] Reported Boniat:

> Recourse was had to the surrounding country for help; permits were given to vessels to bring goods from abroad; in short, the Governor administered as a good pater familas ["father of the family"] and distributed that which he had gathered in the Colony [for] his numerous people, and he succeeded in making their provisions last up to the arrival of the fleet from Havana and St. Domingo …. [Yet] poverty stared them in the face, and these conditions brought all the inhabitants to a state of consternation, which was followed by the death of 1 / 6 of the citizens.[598]

Loans payable over ten years were offered for the poor to rebuild. Later in April, as the remains were cleared away, the Cabildo considered how to avoid such a catastrophe in the future. A philosophy of fighting fires prevailed over preventing them, as the authorities submitted a request for "four pumps … 600 leather buckets … two hooks with a chain … rope … and six hooks with long wooden handles."

Governor Miro's leadership, Don Andres Almonester y Roxas' financial aid, liberalization of trade regulations, a construction boom, and expansion into the city's first faubourg (*Ste. Marie*, today's CBD) rendered New Orleans remarkably resilient following its near annihilation—though not as quickly as residents might have wished. Wrote one observer soon after the fire's anniversary, in a tone of frustration recognizable to post-Katrina New Orleanians,

> inhabitants … are making some exertions to repair the losses of last year by fire. It will nevertheless be a considerable time before the town again exhibits as elegant an appearance as formerly. Abundance of temporary buildings, or mere sheds, [have] been lately erected for the sake of convenience on lots that formerly supported very handsome edifices. It is a common thing here at present for a man worth four or five thousand pieces of eight to live in a shed under which you would scarcely lodge your servants.[599]

New houses soon replaced those temporary sheds, generally exhibiting the same local typological and stylistic traditions of earlier decades. Serendipitously, one of the best surviving examples of that first generation of French Creole domestic architecture—"Madame John's Legacy" at 632 Dumaine Street—is a product of the post-fire Spanish colonial era (and even had an American builder). It arose quite literally on the

ashes of the previous edifice and incorporated some of its components. Although hundreds of French colonial structures disappeared in the Good Friday Fire of 1788, the French colonial architectural *tradition* survived. This would not quite be the case after New Orleans' next great blaze.

Governor Miró was replaced by the equally capable Governor Hector de Carondelet in 1792. The many municipal "firsts" achieved during the Carondelet administration—the city's first theater, newspaper, police force, and navigation canal, to name some—occurred amid three hurricanes and two fires during 1792-94. The worst disaster happened on December 8, 1794, when boys playing in a Royal Street courtyard (a few parcels away from the origin of the 1788 fire) ignited a blaze which swept southwardly with autumn winds. The fire eventually

> reduced to ashes one third of the best buildings of the Capital city, the greatest part of the department stores and other shops and groceries, leaving a large number of families of the very to do class … in need[,] and some of them completely ruined and all the inhabitants stricken with horror….[600]

The conflagration destroyed 212 structures throughout "the most improved and opulent part of that city,"[601] the upriver/riverside quadrant. Combined with the deprivations of five hurricanes, two earlier fires, and numerous floods since 1779, the latest loss was almost too much to bear. In a manner similar to post-Katrina circumstances, the city warned Spanish royals that, "in order to rebuild the city, and in light of the emigration of several useful residents [to] countries less exposed to … detrimental risks[;] great and extraordinary aid is indispensable, which we can only expect of the powerful hand of our August kind Monarch … to grant the loan of 1,000,000 pesos which distributed amongst the owners of the houses burnt in the last fire, will permit them to rebuild …."

While a loan from the King would help the victims rebuild, the Cabildo moved aggressively to *prevent* future fires (rather than concentrating on fighting them) by clearing the cityscape of fire hazards. First to go: clusters of makeshift straw huts erected legally by victims of the 1788 fire, which had since been rented out to non-victims and fallen into disrepair. Next to be removed: two small houses near the Plaza de Armas, "filled with combustible material and with almost no separation from one another," a lesson learned during the 1788 fire. Finally, the repeated fire losses motivated Spanish administrators to look to their own building traditions to foster a more resilient urban environment. Unlike after the 1788 fire, the Cabildo stipulated that new houses funded with the King's loan "must be built of bricks and a flat roof or tile roof," in the Spanish tradition.[602] The new building codes began to transform the city's face, as evidenced by this record from February 20, 1795:

> The Cabildo grants permission to … open a [new] street … on the sole condition that all houses built thereon be of brick with flat roofs, and that on the extreme end of each house, two doors shall be built with a balcony over each, in order that the symmetry of the city will not be disregarded.[603]

The Cabildo further detailed the new construction codes on October 9, 1795. "[I]n order to prevent fires in the future, similar to those [of] 1788 and during the last year," read the Deliberations

> Attorney General Don Miguel Fortier…is of the opinion that in the future…two story houses of two apartments…should all be constructed of brick or lumber filled with brick between the upright posts, the posts to be covered with cement of at least one inch thick, covered with a flat roof of tile or lead.

Those codes transformed wood to brick, clapboard to stucco exteriors, steep roofs to flat roofs, and wooden shingles to tile ones. The Cabildo further stipulated

> That the wooden houses covered with the same material must not be of more than 30 feet deep including the galleries.
>
> That all houses…must precisely have their front facing the street, and nobody is allowed to build them with the rear or sides to the street.

These stipulations eliminated setback distances and brought the buildings right up to the banquettes, in the style of a Spanish city. Concluded the Cabildo,

> [All] citizens must comply with these rules whenever they wish to construct a new building.[604]

Other Spanish features unrelated to fire safety, such as arched openings on the ground floor, pilasters on outside walls, balconies above the *banquettes*, and courtyards in the rear, accompanied the architectural transformation. Soon the fenced gardens and wooden galleries of a French village gave way to the stuccoed walls and wrought iron balconies of a Spanish city. Christian Schultz noticed the new cityscape during his 1808 visit: "The houses of the principal streets nearest the river," he wrote, "are built of brick covered with a slate, tile, or a fire-proof composition."[605] French geographer Élisée Réclus reflected on the transformation during his 1853 visit, even as the old Spanish city evolved again to an American city:

> For a long time, all the houses of New Orleans were simple huts made of wood, [giving] the whole city…the appearance of a huge fairground. Today, the houses of the two main districts are for the most part built with brick and stone.[606]

Evidence of the Spanish architectural transformation abounds throughout the "French" Quarter today: about 740 extant structures exhibit a Spanish-influenced, locally adapted style which may be described as "second-generation Creole" (see *Architectural Geography, 1710s to 1810s*). In addition, twenty-five edifices—about one of every 100 buildings in the Quarter—exhibit the pure Spanish Colonial style mandated after the 1794 blaze. Geographically, they cluster within two blocks of the intersection of Toulouse and Royal streets—not coincidentally the same blocks obliterated

by the two great fires. They are particularly concentrated on the 600 block of Chartres Street—within a spark's leap of the origins of both great conflagrations.[607]

"May Heaven Avert Another Such Catastrophe"

The Mississippi River as a flood threat to New Orleans

The Mississippi threatened New Orleans with hazards even as it blessed it with resources. The river's natural dynamism—to humans, its unacceptable unpredictability—endangered the river-dependent port city seasonally through spring flooding, occasionally through bank erosion, and potentially through channel jumps.

Under natural conditions, the Mississippi River inundates the deltaic plain in two ways. During most springs, high waters overtop the crest of the natural levee and send over it a thin sheet of water (overbank flooding) toward the backswamps. A plantation owner recollected in 1793 one such event: "... New Orleans in its beginning was frightful, the river at its height spread out all over the land, and there were two feet of water in all the houses which caused general sickness and death."[608]

Alternately, a weak spot in the natural levee occasionally erodes into a *crevasse* ("breach"), which allows river water to surge through a focused flow toward the backswamp. Sometimes overbank and crevasse flooding occur simultaneously.

A complete chronology of floods in New Orleans resists easy compilation, because no single agency kept consistent, detailed records until the late 1800s. According to one 1882 report, "partial inundations by the river" afflicted New Orleans in 1719, 1735, 1785, 1791, 1799, 1816, 1849, and 1862, while "partial inundations by Lake Pontchartrain or by this lake aided by the river"[609] occurred in 1831, 1837, 1846, possibly in 1853 and 1854-55, 1856, 1861, 1868, 1869, 1871, and 1881. Data on lake floods prior to 1830 were either lost or never recorded, but the source states that such floods were "much more numerous" than direct overbank river flooding, which became increasingly rare as levee construction improved.[610] Gould's *Forty Years on the Mississippi* adds 1780 to the list of colonial-era crevasse floods; Kendall's *History of New Orleans* (1922) adds 1813 to the record of crevasse floods and 1844 as a lake flood; and a recent Army Corps source adds 1850, 1858, 1865, 1867, and 1874 to the list of flood years.[611] In 1890, high river water topped the levee in the French Quarter and, via an upriver crevasse, raised the level of the lake which thence flooded the lakeside marshes up to the Metairie Ridge. Another study found that the river reached flood stage at New Orleans (but did not necessarily inundate the city) once every 4.07 years on average, from 1871 to the 1930s.[612]

"*Crevasse[s]*, the name given to a fissure or breaking of the Levée," wrote John

Adems Paxton in 1823, "are occasioned [firstly by] the yielding of the Levée; and secondly, the sinking of the bank of the river…"[613] That latter phenomenon was also called *éboulis* or *éboulemens*, meaning landslides of the river bank, or land cave-ins.[614] The resultant deluges accounted for the city's worst historical natural disasters. "The waters rush" through a Mississippi crevasse, wrote one visitor in the early 1800s, "with indescribable impetuosity, with a noise like the roaring of a cataract, boiling and foaming, and bearing every thing before them. Like the breaking out of a fire in a town, it excites universal consternation."[615] Indeed, *crevasse* was as dreaded a word in nineteenth-century Louisiana parlance as *fire*, *hurricane*, or *yellow fever*.

On May 6, 1816, a weak spot in the levee on Barthelemy McCarty's plantation in present-day Carrollton opened up into a crevasse, inundating the backswamp to the rear flanks of the city five miles downriver. "One could travel in a skiff from the corner of Chartres and Canal streets to Dauphine," read one account, "down Dauphine to Bienville, down Bienville to Burgundy, thus to St. Louis Street, from St. Louis to Rampart, and so throughout the rear suburbs."[616] Even with this destructive hazard came a valued river-borne resource: "the receding water," noted one historian, "filled the low terrain with alluvial deposits enriching the soil as well as elevating the swamp sections."[617] That summer also proved to be unusually healthy for the population—only 651 deaths occurred in New Orleans in 1816, compared to 1,252 in 1815 and 1,772 in 1817—probably due to the massive unplanned spring cleaning of the filthy port city.[618]

Thirty-three years later, a levee deteriorated on Pierre Sauvé's sugar plantation in the present-day River Ridge section of Jefferson Parish. Starting May 3, 1849, river water widened the crevasse to 150 feet long and six feet deep, slowly filling the hydrological basin between the river's natural levee and the Metairie Ridge. The deluge surpassed the New Basin Canal on May 8, reached Rampart Street on May 15, and peaked on May 30-June1 at the intersection of Bourbon and Canal Street.[619] A few days later a *Daily Picayune* journalist described the view from the 185-foot-high cupola of the St. Charles Hotel:

> Far away to…Carrollton [and up to] the Sauvé crevasse, the surface of the country on the left bank of the Mississippi is one sheet of water, dotted in innumerable spots with houses… barns, out houses, lofty trees and brush wood…. The whole of the streets in the Second Municipality…are now so many vast water courses, or aquatic highways, issuing as it were from the bosom of the swamp…. Indeed, there is no place with which we can compare New Orleans…, that would give the absent traveller so correct an idea of its topographical features, as the city of Venice.[620]

Volunteers heroically plugged the crevasse on June 20, but not before 220 city blocks, 2,000 structures, and 15,000 residents were flooded up to seventeen miles away. Within a few days, water receded from most city streets (though not yet from the backswamp or rural Jefferson Parish) by draining out through the New Basin Canal and Bayou St. John, or evaporating in the summer sun. Displaced citizens returned home to clean up and rebuild; pavement, gutters, wharves, levees, and city structures bore enough damage to warrant a special tax levied to fund repairs. The deluge left behind

a "deposit of alluvion [with] vegetable and animal matter," concerning officials that "an active agent of disease—the *materies morborum*" threatened the population. Only months earlier, cholera had killed 3,176 New Orleanians. But heavy rains washed away the filth, and as in 1816, death rates actually declined after the flood.[621]

Other crevasse floods followed, including four at Bonnet Carré over the subsequent three decades. The Sauvé Crevasse of 1849 ranked as the worst inundation in the city's history until Hurricane Katrina and the levee failures of 2005, and remains the city's worst river-originated deluge. Yet, for all the damage, only 10 percent of the citizenry suffered flooding, and very few perished—compared to over 60 percent flooded and well over a thousand dead during Katrina. Nineteenth-century New Orleans endured natural disasters by accommodating their effects through its urban form, principally by building sturdy, raised structures in high density on elevated ground. And frequent the disasters were.

> May Heaven avert from us such another catastrophe! May our citizens, in their foresight and their intelligence, devise some means of raising an insuperable barrier to another inundation from [the Mississippi River]![622]

So implored the *Daily Picayune* journalist covering the Sauvé flood. His prayer was answered within a few decades: increasingly sophisticated levee construction following the federalization of flood control (1879) gradually reduced the river's threat to New Orleans. When the Great Mississippi River flood of 1927 inundated the lower Mississippi Valley, federal riverfront levees succeeded in sparing New Orleans what could have been a catastrophic deluge. That a crevasse was intentionally dynamited in the Caernarvon levee below New Orleans to guarantee the safety of the prosperous city at the expense of poor, rural Plaquemines Parish, remains one of the most controversial incidents in local history. The 1927 flood revealed the imprudence of the long-standing "levees only" policy for river flood control and demonstrated the need to *accommodate* the will of the river. Afterwards, spillways—which are essentially controlled crevasses—were installed at Bonnet Carré and Morganza to serve as "safety valves" in times of extremely high water: seventeen feet above sea level in stage, or 1,250,000 cubic feet per second in volume.

The Mississippi River still potentially threatens New Orleans—the Bonnet Carré Spillway has been opened in 1937, 1945, 1950, 1973, 1975, 1979, 1983, 1997, and 2008—but not in over a century has Mississippi River water significantly impinged directly upon Orleans Parish. Yet the legacy of the old threat lingers, affecting urban growth, influencing residential settlement patterns, spooking investment, and diverting scarce resources.

Riverfront levees in the twentieth century form the single most influential man-made feature in the deltaic landscape, protecting people, creating value, and encouraging urban development even as they occasion subsidence and coastal erosion. They held fast when Hurricane Katrina's residual Category 3 surge raised the river's stage from four feet to sixteen feet above sea level. The same cannot be said of the slender levees and floodwalls lining the city's intricate network of drainage and navigation

canals. Their failure formed the proximate (though not the ultimate) cause of the city's worst flood ever.

Geographies of Nuisance and Risk

A brief history of the back-of-town

The spatial distributions of that which made urban living more or less pleasant, safe, and opportune—and thus more or less costly—drove the residential settlement patterns of class, race, ethnicity, and nativity. These patterns are discussed in *Populating the Landscape*; investigated here are the underlying geographies of nuisance, risk, and inconvenience—or, alternately, of amenity, safety, and convenience.[623]

Although urban development in mid-nineteenth-century New Orleans occurred almost entirely on the natural levee, not all sections of that feature were equally valued. Those closest to the river boasted transportation advantages and the highest, best-drained elevations, but suffered from the environmental nuisances associated with riverfronts: smelly wharves and stockyards, unsightly warehouses, vermin, noisy railroads, traffic and activity at all hours, not to mention rough characters, saloons, "caravanserai" (inns for transients), and batture squatters. While ideal for commercial use and replete with low-skilled employment opportunities, riverfront blocks ranked less desirable for residential living and attracted housing stock accordingly.

Those areas farthest from the Mississippi avoided those riverfront nuisances, but suffered a different set of challenges. Lowest in elevation and closest to the mosquito-infested, flood-prone swamp, the so-called back-of-town ranked the riskiest, cost the least, exhibited the most primitive urban infrastructure, and inspired the humblest housing stock. Well into the twentieth century, "the deep black morass," as one official city document called the old backswamp, was remembered as "New Orleans' deadliest enemy," and its recent drainage hailed as a courageous conquest."[624]

The perception of a back-of-town dates to the city's earliest years, when the higher blocks "fronting" the river developed first while the lower blocks in the "back" remained muddy and less desirable. In the front were the *Place d'Armes* and important structures, such as the Company warehouse, the governor's house, the manager's office, the planned church, the *presbytère*, and the residences of prominent colonists. In the back were less-desired features such as the hospital, cemetery, animal-processing facilities, weedy lots, and the abodes of commoners. Wrote the governor of the colony in 1728, "There is already a place reserved for a market *in the front of the city* and enough remains *in the rear to establish slaughter-houses there*…."[625] Sixty years later, the Spanish Cabildo made a similar decision regarding the original low-ground city cemetery at St. Peter and Burgundy, which, decades earlier, marked the uninhabited rear flanks of

the city but now abutted developed blocks:

> [Such] a great number of people [are] buried in the cemetery… that there is no room for any more; and at the time of digging the graves, the remains of other deceased are found, which not only cause annoyance but [also] bad odors which due to the *proximity to the City* may be the cause for *infection [and] epidemics of disease*… [Thus] it was deemed necessary to establish another cemetery, *located further from the City*.[626]

St. Louis Cemetery was created shortly thereafter, forty yards from another perceived nuisance—Charity Hospital—which too was unwanted in the front-of-town. Still active today, the famous St. Louis #1 Cemetery is a relic of the old colonial-era back-of-town.

The racial segregation of public recreation also exhibited a front/back urban geography. Free people on Sundays strolled riverfront promenades and the landscaped gardens and squares of the front-of-town; slaves also had the day off, but were relegated elsewhere:

> [A] walk in the rear of the town will… astonish [your] bewildered imaginations with the sight of twenty different dancing groups of the wretched Africans, collected together to perform their *worship* after the manner of their country. They have their own national music, consisting… of a ring kind of narrow drum of various sizes, from two to eight feet in length, three or four of which make a band. The principal dancers or leaders are dressed in a variety of wild and savage fashions, always ornamented with the tails of the smaller wild beasts, and those who appeared most horrible always attracted the largest circle of company. These amusements continue until sunset, when one or two of the city patrole show themselves with their cutlasses, and the crowds immediately disperse.[627]

Thus concluded a spring evening at Congo Square, 1808, a few blocks away from the cemetery, the mortuary, and the swamp.

The front-of-town/back-of-town spatial perception permeates New Orleans history and remains evident in the lexicon and "mental maps" of present-day inhabitants. Exact locations and dividing lines vary depending on the era and the speaker. Around 1800 the back-of-town would have lay alongside of roughly Rampart Street; two or three generations later, around Claiborne or Broad. A 1915 article described the "back of town [as] that section lying between Esplanade avenue and Tulane avenue and Claiborne avenue to the cemeteries on the Metairie/Gentilly Ridge."[628] Most other usages of the term implied a nebulous region with soft boundaries. One thing was certain: if you were in the back-of-town, you knew it. That which was malodorous, offensive, unsightly, or dangerous usually gravitated to the back (or downriver); that which was attractive and agreeable generally blossomed toward the front. Yet the back-of-town afforded certain working-class opportunities, particularly in the antebellum era. Canal excavation, truck farming, railroad construction, tanneries, slaughterhouses, and similar operations dependent on unskilled labor and cheap real estate, which could not be found in the city center, abounded here.

Desirability of land in historic New Orleans also varied with distance from the urban core. Lack of mechanized transportation made life on the urban periphery inconvenient and thus cheap, even more so for the abundant supply of land there. Life in or near the city center, on the other hand, was convenient but scarce and therefore valuable. This pattern is an ancient one—"in many medieval cities in Europe, the city centres were inhabited by the well-to-do, while the outer districts were the areas for the poorer segments of the population"[629]—and it carried over to most New World cities.

Desirability of land thus varied (1) *directly* with distance from the river, (2) *indirectly* with distance from the backswamp, and (3) *indirectly* with distance from the city center. In other words, areas too close to the river, too close to the backswamp, or too far from the central city all constituted less desirable zones. On the other hand, areas that lay farthest from sources of nuisance and risk, *and* closest to amenities and opportunities—the middle of the natural levee near the inner city—commanded the highest prices and attracted the greatest investments in infrastructure and housing. These areas comprise the present-day historic neighborhoods extending from the Central French Quarter through the Central Business District and Coliseum Square and (later, with streetcar service) into the Garden District and up St. Charles Avenue.

With the introduction of mechanized transportation and later automobiles, the factor of distance became less weighty in influencing land values; wealthy areas thus developed farther uptown, close to the attractive new amenities of Audubon Park and the new university campuses of Tulane and (later) Loyola. Streetcars allowed these moneyed citizens to commute to the inner city. Still, the factors of nuisance and risk kept the prosperous area restricted to the middle of the natural levee, within a few blocks of St. Charles Avenue (not coincidentally the route of the original streetcar line).

With augmented levees on the Mississippi River and Lake Pontchartrain, plus a new municipal drainage system pumping out impounded swamp water, the ancient nuisances and risks of the backswamp lost their importance in the minds of early-1900s New Orleanians. Confident that technology had "fixed" this geographical problem, thousands of mostly white middle-class residents deserted their historical front-of-town roots and "leapfrogged" over the mostly black back-of-town, settling in new whites-only subdivisions in Lakeview and Gentilly (see *"Two Centuries of Paradox"* and *The White Teapot*). After the Civil Rights Movement, many black families did the same, settling mostly in the modern Orleans Parish subdivisions east of City Park and eventually New Orleans East. The old front-of-town/back-of-town perception weakened, but it did not disappear entirely because those earlier geographies of nuisance and risk left behind an assortment of poor, troubled neighborhoods.

In addition to the front/back dimension to its urban geography, New Orleans also revolved around a riverine "up"-and-"down" axis. The inclination to keep the water source pure (relatively speaking) meant that objectionable operations tended to gravitate not only backward, but downriver, toward what is now the Lower Ninth Ward (see *How the Poor Third Became the Lower Ninth*). It was not by chance that the odious business of stocking and slaughtering animals ended up in the city's lowermost corner, after the state legislature mandated the consolidation of butchering activity in 1869. Nor was it a coincidence that the city's sewerage treatment plant ended up in back-of-

town quadrant of the lowermost zone. That engineers sited the Industrial Canal in the Ninth Ward can also be partially attributed to the fact that it lay below the city proper and away from its more desirable sections. Slaughterhouses, railroad yards, canals, sewerage plants, petrochemical industries, and the like tended to get shoved downstream, where they deflated property values, drove away moneyed citizens, and attracted those who had to settle for less. This helps explain why the downriver half of the metropolis (downtown New Orleans and St. Bernard Parish) has always been poorer, in the aggregate, than the upper half (uptown New Orleans and Jefferson Parish)—just as the back-of-town ranks poorer than the front.

Perceptions of environmental safety that informed—and oftentimes misinformed—New Orleanians' residential settlement decisions were turned on their heads on August 29, 2005, when Hurricane Katrina reminded us that the old geographies of risk remained very real. Levees, drainage systems, and flood-control structures had in fact, as we learned that day, only exacerbated the old risks; worse yet, they dangerously lured residents into the flood-prone areas and lulled them into complacency with a false sense of security.

Whatever the future of the flooded region, this much is certain: the geographies of nuisance and risk will continue to drive the human geography of New Orleans. One can only hope that, in the future, *perceived* levels of risk will match actual levels—and inspire people to settle out of harm's way.

The Great Storm of 1915

Why a big storm incurred relatively little damage

The hurricane that set the tone for early-twentieth-century New Orleans arrived fifty years before Betsy, did the same for the late-twentieth-century metropolis, and ninety years before Katrina repeated the experience in the twenty-first century. Unnamed and uncategorized, the tempest became known locally as "the Great Storm of 1915."

Sailors first detected a tropical depression over the Lesser Antilles on September 22, only a month after a hurricane killed over 400 people in Galveston. A smooth arc-shaped track routed "the blow" (as newspaper writers called hurricanes in those days) between the Yucatan Peninsula and Cuba, with minimal land-induced weakening. By the time it leaned toward New Orleans, wind speeds topped 135 m.p.h.

An ominous "cirrus veil" clouded city skies Tuesday morning, September 28. The tense day ended with a "faint brick-dust" sunset; nighttime brought with it the system's outermost rainy feeder bands.[630] After making landfall over Grand Isle,

the hurricane veered gently to the north northeast, positioning New Orleans in the storm's dreaded northeastern quadrant. By dawn on the twenty-ninth of September, winds in the city gusted at 40 m.p.h. and steadily increased. Lake Pontchatrain's waters swelled suddenly, in late morning, to five feet above normal—the highest recorded at the time—while coastal and gulf waters rose approximately fifteen to twenty feet. So abruptly had the tide risen that the last train through the eastern marshes, flagged down by desperate people seeking to evacuate, had to plow through violent surf to reach the city (see *Manual's Dilemma*).

The surge overtopped the meager levees lining the lakeshore, adjoining outfall canals, the New Basin and Old Basin navigation canals, and Bayou St. John. "The overflow from these sources [plus] about 7¼ inches of rainfall, was a most discouraging feature of this day's development," wrote a Sewerage and Water Board engineer tasked with keeping the pumps operating.[631] Salt water filled the bowllands from present-day Broadmoor to Lakeview (largely uninhabited at that time). "Over that portion of the city lying between the Old Basin Canal and Broadway and from Claiborne Avenue out to Lake Pontchartrain," wrote the famed forecaster Isaac Cline, "the water depth driven in by the storm ranged from 1 to 8 feet in depth."[632]

A bigger threat came from a crevasse (that old French term was still in use in this era) in the Florida Avenue rear protection levee, flooding sections behind St. Claude Avenue in the Seventh, Eighth, and Ninth wards. Meanwhile, the Mississippi River rose six feet above normal stage in uptown and even higher in St. Bernard and Plaquemines parishes, where it spilled laterally over the riverfront levees and swept across the low country.

Winds blew to 80 m.p.h. at 5:10 p.m., with gusts easily topping 100 m.p.h. They then paused eerily and, around 6:35 p.m., reversed directions, as the eye passed twelve miles west of the city. A few hours later, a *Times-Picayune* reporter described "a peculiar lightening ... flaring up in sheets not unlike the fire coming out of the mouths of serpents...."[633] The 300-mile-wide system proceeded northward along the western shore of Lake Pontchartrain, pummeling Tangipahoa and St. Tammany parishes even as their terrestrial surface robbed the system of energy. New Orleanians peered out their windows and surveyed their circumstances. "CITY CUT OFF FROM REST OF WORLD," read a worried headline in that evening's *Item*.[634] Nevertheless, the worst was over.

By Thursday morning, the sun shined over the Crescent City. Damage was extensive, mostly from wind. Wrote the *Times-Picayune* the day after:

> Numerous public buildings suffered and hundreds of homes were damaged severely, many being blown down. Scarcely a house in New Orleans escaped without a scratch. Several big churches seem to have been singled out as particular victims of the storm's fury. Department stores, hotels and other big buildings in the business district suffered. Street traffic was almost paralyzed ... and was rendered perilous by flying glass and debris ...[635]

Over 25,000 structures experienced serious structural damage. Prominent landmarks seemed to suffer disproportionately: at least eleven major churches lost their

steeples and adjoining towers, certain French Market pavilions were leveled; the Old French Opera House was severely damaged; and the famous St. Louis Hotel was so battered it was subsequently demolished. The deluge receded naturally everywhere except levee-encircled areas, where trapped water took four days to pump out via the recently installed drainage system. Damages exceeded $13 million region-wide, in unadjusted 1915 dollars, with roughly half occurring in New Orleans. At least 275 Louisianians perished. Within weeks of reviewing the scientific data, the nation's top meteorologist described the storm as "the most intense hurricane of which we have record in history of the Mexican Gulf coast and probably in the United States."[636]

The marvel of the Great Storm of 1915 was not the extent of its damage, but its limit. "*'STORM PROOF!' The Record Shows New Orleans*," crowed the *Item*'s editorial page the day after.[637] Indeed, the system arrived stronger and better positioned, compared to Hurricane Katrina in 2005, to devastate New Orleans utterly. Five reasons explain why it did not.

First, coastal wetlands spanned far more acreage and exhibited healthier conditions than they do today. An additional 2,000 square miles of marsh padded the population regions of southern Louisiana in the early 1900s, acting as a buffer and absorber of gulf surges.

Second, no major modern navigation canals allowed gulf waters to penetrate the city's heart. The Industrial Canal was barely in planning stages; the Intracoastal Waterway did not yet exist; and the Mississippi River-Gulf Outlet Canal was not yet envisioned. No "funnel" existed in the eastern or southern marshes to allow the enemy to the heart of the fort. The extent of flooding that did occur happened in large part because of the two existing man-made navigation waterways, the New and Old Basin canals.

Third, a state-of-the-science municipal drainage system had just been installed to pump out standing water from within the bowl. That same system is now a century old.

Fourth, the drainage system, for all its effectiveness, had not yet had enough time to remove the water component from the soil bodies of the lakeside marshes. These areas, while slightly below sea level in some places in 1915, had not yet subsided nearly as deeply as they are today, after ninety additional years of sinkage. A less deep bowl means shallower floodwaters.

Finally, urbanization of the lakeside marshes had barely begun by 1915; most New Orleanians remained on the higher ground closer to the Mississippi River. Rather than inhibiting the development of these areas, the Great Storm of 1915 paradoxically encouraged it, by inspiring what became the Lakefront Improvement Project (see *"Ornament to the City"*) and other flood-control measures. This massive flood-protection project created new upraised land in an effort to protect the rapidly developing former marshland behind it. In the end, it demonstrated that, in coastal Louisiana and elsewhere, flood-control structures intended to protect people often end up drawing them into harm's way. Those very areas flooded severely during Hurricane Katrina, at a cost of hundreds of lives.

Manuel's Dilemma

Drama in the Rigolets during the Great Storm of 1915

Official records of historical hurricanes are replete with antiseptic meteorological data and generic descriptions of death and destruction. The searing first-hand experiences of everyday people usually went undocumented. But occasionally, often serendipitously, one comes across stories of the human dramas that played out during those apocalyptic moments. They serve to bind those long-gone lives with the region's latest generation of storm survivors, and perhaps teach lessons in need of learning. Manuel Marquez of the Rigolets tells one such story.

The Rigolets "land bridge," a marsh-impounded ridge created by an abandoned river distributary in extreme eastern Orleans Parish, is supremely vulnerable to gulf tempests. With enough warning, residents of this and other coastal marshes traditionally evacuated to the higher, levee-protected city of New Orleans when a hurricane approached.

Such a tropical system developed in the Caribbean during the last week of September 1915. Forecasting and communications as they were in that era, denizens of the Rigolets saw the odds in their favor and continued about their lives. But on Tuesday, September 28, reports from ships confirmed that the immense hurricane imminently threatened the Barataria and Terrebonne basins of southern Louisiana. New Orleans in general and the Rigolets in particular found themselves aligned with the system's dangerous northeastern quadrant. Feeder bands swirled over the metropolis by dusk.

Official warning of an unequivocal strike went out at 5:20 a.m. next morning from the Weather Bureau office of the famous hurricane forecaster Isaac M. Cline. A worried *Times-Picayune* reporter asked the chief about the fate of the Rigolets, where some acquaintances of his were staying at the Anglers' Club.[638]

"[You] had better telephone them at once[!]," admonished Cline, which the reporter did. Miraculously, the call went through to Manuel Marquez, a fifty-one-year-old black Creole from the Seventh Ward who worked as the caretaker of the fishing lodge.[639] The reporter urged Manuel to gather all patrons and flag down the very next train, due at 10 a.m., for a last-minute evacuation to the city.

"[T]he train [will] not stop for [us]," Manuel countered as if experienced in this rejection.

"[Then] put a cross tie on the track" and force them to stop!, pleaded the reporter.

"They will put me in jail," Manuel groused.

"You would be better off in jail than where you are now and for God's sake stop that train at all hazards and come to New Orleans[!]" shouted the reporter.[640]

Manuel had much to lose, the least of which were his job and responsibilities

to the club members. His wife, sister, children, grandchildren, relatives, and friends, huddled nearby, also looked to him for salvation.[641]

Winds by this time surpassed 40 m.p.h., swelling the brackish waters of lakes Catherine, Borgne, and Pontchartrain to one, two, three feet above normal levels. Having squandered earlier evacuation opportunities and now seemingly out of options, "occupants of the Anglers' Club apparently considered it the wisest course to remain" in the coastal clubhouse.[642] Cline's interpretation of the members' decision differed: "absolute disregard of specific warnings and advice to evacuate, he called it.[643]

Hope came in the form of the last train to New Orleans, the *Mobile Limited*, steaming through gusting surf along the Louisville & Nashville tracks from Alabama and the Mississippi Gulf Coast. Manuel flagged it down frantically, hoping for mercy but expecting to be bypassed. *"Put a cross tie on the track[!],"* he remembered the reporter saying. But need the train, already filled with apprehensive passengers, screeched to a stop.

Manuel's salvation had arrived, but his kin and patrons remained scattered throughout the compound, hunkered down for safety. *Wait, wait!* cried Manuel to the engineer as he raced away from the very train he worked so hard to summon. Anxious and bewildered faces gaped at him from the rain-splattered windows of the passenger cars as he frantically ran off to seek his people.

Winds whipped up higher and wilder waves "with ever-increasing savageness,"[644] splashing salt water dangerously against the locomotive's hot boiler and greased pistols. Passengers hardly assured of their own survival grew agitated and then enraged at the seemingly endless delay. Every passing moment increased the odds that Manuel and his people would make it safely to the train, but decreased the chances that the train would ever arrive safely to the city. Consider the passengers' frenzied debate: At what point does the possibility of everyone surviving evaporate, leaving them to choose between *all* perishing, or *some* perishing? When the winds and surf suggest that point is about to pass, who among us would choose the former?

The passengers' dilemma pales in comparison to Manuel's. He could have boarded the train to save his own life and, if circumstances permitted, his family's. But he convinced himself that all others could be saved if he were only granted a moment to gather and guide them to the train. Seemingly blocking out the fact that the passengers could easily trump his decision, off Manuel waded to search for his people. Who among us would not?

Colossal decisions—involving evacuating, relocating, hunkering down, giving up, resisting, conceding, fighting, accepting—confront citizens of New Orleans and southeastern Louisiana, oftentimes to the exasperated and impatient disbelief of Americans elsewhere. *Should we remain in eroding marshes and continue centuries of tradition, or end our way of life and move inland so that aggressive coastal restoration may commence? Should we maintain all low-lying, far-flung neighborhoods and trust that levees will protect us? Or should we concede these areas to nature and build only on higher ground? Should we try to save everyone, at the risk of losing everyone? Or should we ask some to sacrifice everything so that others may maintain something? Shall we strive toward the probable survival of half the society, or the possible survival of the entire society?* Manuel's dilemma,

and that of the passengers, is Louisiana's dilemma.

Perhaps Manuel succeeded in finding some members of the group. Apparently he ran back to ensure the engineer would not move the locomotive before he gathered the others. But "the rising tide was jeopardizing the passengers on the train," Cline later wrote in his report, "which could not wait until the people could be collected from the houses. Manuel returned to his companions," and the train departed without them.[645]

History does not record the trip across the windswept marshes and surging Lake Borgne. We also know that "the last train in on the Louisville and Nashville [line] was the Mobile Limited, which reached the city at 11:50 o'clock a.m., [having gone] some distance... through water."[646] The passengers' decision to abandon their fellow citizens surely weighed heavily on them as their own fate played out. Some sense of guilt might have abated when, after departing the Anglers' Club, the passengers spotted a work train on a side track and a coal barge in a nearby canal, both of which eventually saved the lives of many stranded Rigolets denizens. Manuel and his people could have sought refuge there.[647]

What they in fact experienced late that afternoon was terrifying. Fierce surges fifteen to twenty feet high rendered the entire Rigolets marsh part of the Gulf of Mexico. Bridges and trestles along the Louisville and Nashville tracks were destroyed utterly. The "Anglers' Club... was literally splintered into kindling wood."[648] New Orleans itself suffered extensive wind damage and flooding.

When the Great Storm of 1915 had passed, Rigolets residents made their way back to their land. The physical environment endured the hurricane well; it might have even benefited, as gulf storms often deposit offshore sediments upon coastal wetlands. Had the structures been built with appropriate strength and height, and had residents evacuated promptly, the hurricane would have represented a survivable inconvenience. Instead, it was a tragic disaster, to both the built environment and its humanity. Reported the *Time-Picayune* correspondent who telephoned Manuel the morning prior, "The survivors... were so distracted they did not know what to do with the bodies after they found them. Relatives of the dead were so downhearted and so "sick" of [this] place... they pleaded that the recovered bodies be buried elsewhere."[649]

But what of Manuel?

"[W]hen the storm was over," wrote Isaac Cline at the conclusion of his poignant scientific report, Manuel's "lifeless body, with 23 others of those who were in the club, were found strewn over the marshes." Among the dead were his wife, sister, at least two and possibly all five of his children plus four grandchildren, fellow employees, neighbors, and club members, whose own individual decisions collectively created Manuel's dilemma.

Hurricane Betsy

The unfinished business of the 1965 storm

In the late afternoon of August 26, 1965, a tropical depression formed 600 miles north of the South American nation of Surinam.[650] It grew to a tropical storm—the second of the season, named "Betsy"—as it moved northwestwardly over the Windward and Leeward islands, only to wobble and stall for two tense days north of Puerto Rico. Now a hurricane, the system slowly resumed a northwestward path on September 1, then stalled again 300 miles off the central Florida coast. Communities of the southeastern U.S. coast and island nations anxiously awaited the tempest's next move, while those in Miami and the Gulf Coast breathed easier. But on the night of September 6, Betsy wobbled southwardly, away from the East Coast, then started straight west, striking between Miami and Key West in the wee hours of September 8. The system, despite any of its Atlantic indecisiveness, then swept northwestwardly across the Gulf of Mexico at an exceedingly fast clip of twenty knots. Given the forecasting technology of the time, Betsy's stunning bolt robbed coastal residents of precious hours needed for evacuation. Heroic efforts of individuals and local governments nevertheless aided 90 percent of the quarter million people of the southeastern Louisiana coastal area to evacuate to shelters on higher ground.[651]

In metropolitan New Orleans, "evacuation" meant not the major metropolitan exodus practiced today, but micro-scale, intra-urban movement to sturdier structures such as old brick schoolhouses. With over 600,000 city residents (many without vehicles) and no modern interstates, a mass flight from the deltaic plain was neither possible, nor recommended, nor even envisioned. Most New Orleanians felt safe in the city and "rode out" the storm at home or in neighborhood schools or civic buildings; coastal residents evacuated *to* levee-protected New Orleans.

Betsy approached the southeastern Louisiana coast on what appeared to be, from New Orleans' perspective, a worst-case-scenario track. Radar systems based in the city first picked up the eye at 11:03 a.m. September 9; eleven hours later, Betsy made landfall directly over Grand Isle. The straight northwestward path, roughly parallel to the west bank of the lower Mississippi, meant the fiercest winds buffeted the Barataria Basin and the river towns of Venice, Buras, and Port Sulphur. Winds, swirling in from the north, peaked in Port Sulphur at 100 m.p.h. before the recorder failed; elsewhere they gusted to 140 and even 160 m.p.h. Areas east of the river saw only slightly weaker winds.

Betsy's low barometric pressure and winds lifted and pushed a dome of gulf water into southeastern Louisiana and coastal Mississippi. Coastal waters rose to 6.4 feet above mean sea level in Pascagoula, Mississippi; 8.4 feet in Biloxi; 10.7 feet in Gulfport; 10.6 feet at the Rigolets land bridge at the mouth of Lake Pontchartrain; 9.3 feet

in the newly excavated Mississippi River-Gulf Outlet (MR-GO) Canal, five to seven feet at the mouth of the Mississippi, seven to nine feet in the lower Barataria Basin, and four feet at Morgan City. The swollen gulf backed the Mississippi River up upon itself, forcing water over the levees all along the river's lowermost fifty-three miles. In New Orleans proper, the river at the Carrollton Gauge rose from a normal late-summer stage of around three feet above sea level to 12.5 feet. Betsy's surge was, at the time, the highest ever recorded in the region, due in part to the slower forward speed of the storm.

Hurricane Betsy pummeled New Orleans proper around midnight of Thursday-Friday, September 9-10, accompanied by 5.13 inches of rain falling over thirty hours. Winds in metropolitan New Orleans sustained at 75-85 m.p.h. and gusted to 110-125 m.p.h. Surge levels at the Seabrook and Paris Road bridges, which span the Industrial and Intracoastal Waterway/MR-GO canals, rose to six and ten feet.

After Betsy's weakening eye—roughly the size of Lake Pontchartrain—proceeded past Baton Rouge (which experienced 60-80 m.p.h. winds) at dawn Friday, it drifted up the Mississippi and Ohio river valleys and finally petered out in Ohio over the weekend.

We have an aerial image snapped as daylight broke on Friday, September 10, most of southeastern Louisiana—over 4,100 square miles, over eleven parishes, from the Atchafalaya River to the Chandeleurs Islands and from Ponchatoula to South Pass—would have blended seamlessly with the Gulf of Mexico. Only the natural levees of the Mississippi River and Bayou Lafourche, plus the levee-protected western half of metropolitan New Orleans, remained dry. Those areas were home to the lion's share of the region's 1,171,800 people. Eastern regions were less fortunate: salt water inundated Plaquemines, St. Bernard, and eastern Orleans parishes, plus large expanses of mostly uninhabited zones of eight other coastal parishes. In all, 187,900 people, or 16 percent of the regional population, saw their homes flood. Depths region-wide varied by topographic elevation: populated portions of urbanized St. Bernard saw one to three feet of floodwater, while as-yet undeveloped lowlands saw seven to nine feet. Plaquemines and St. Bernard residents' homes inundated at the highest rates (96 and 61 percent of the population, respectively), while Orleans Parish had by far the most flood victims (141,600 out of 627,525, or nearly one of every four Orleanians.)[652] The disaster did not prevent President Lyndon B. Johnson from arriving directly into the flood zone on the day after Betsy to meet with Ninth Ward flood victims.

Flooding within New Orleans occurred mostly along—and on account of—three man-made navigation canals scoured into the eastern marshes during the previous five decades: the Industrial Canal, the Intracoastal Waterway (ICWW), and the adjoining Mississippi River-Gulf Outlet Canal (MR-GO), still under construction even as Betsy demonstrated its folly. Those waterways and their spoil levees funneled wind-blown gulf waters into the heart of the metropolis. The surge penetrated five of the city's dozen or so hydrological sub-basins via levee-overtopping and levee-breaching, particularly along the west side of the Industrial Canal from Florida Boulevard and Claiborne Avenue. This sheet of water filled sections of the Seventh, Eighth, and Ninth wards lying within the hydrological sub-basin formed by the Gentilly Ridge, Esplanade Ridge, and natural levee of the Mississippi. These racially mixed back-of-town neighbor-

hoods saw 6,350 homes and nearly 400 businesses flood, in places by as much as seven feet. The rising tide failed to surpass the Gentilly Ridge but nevertheless backed up the drainage canals that traverse that natural topographic crest, resulting in two to four feet of flooding in an all-white portion of Gentilly and the adjoining all-black neighborhood of Pontchartrain Park (opened nine years earlier as the city's first modern subdivision for African American home-buyers). Over 200 homes and a dozen businesses were swamped in these two lakeside neighborhoods.

Overtopping of the ICWW and Industrial Canal levees accounted for the flooding of New Orleans East. At the time, most residential development there occupied the higher sections of Chef Menteur Highway and the lakeside Citrus and Little Woods enclaves along Wayne Boulevard, most of which were spared. Lower, mostly uninhabited areas ponded floodwaters at depths ranging from two to eight feet. The rural eastern marshes and St. Catherine community in the Kingslets, all unprotected by levees, witnessed fierce surges at the peak of the storm but did not suffer stagnating flood, because while no levees blocked water from coming in, neither did they prevent it from flowing out. About 1,330 homes and 140 businesses flooded by an average of three feet throughout the area east of the Industrial Canal and north of the ICWW.

Hardest hit of all was the Lower Ninth Ward. A series of Industrial Canal levee breaches along the Southern Railroad tracks, coupled with overtopping, deluged the poor, mostly black section of this neighborhood by three to five feet along St. Claude Avenue and to nine feet along the back levee. Only the streets closest to the Mississippi River—present-day Holy Cross, a working-class, majority-white area at the time—evaded the flood. Severe flooding damaged or destroyed thousands of homes and hundreds of businesses throughout the Lower Ninth Ward, plus portions of Jackson Barracks. It would take over two weeks of pumping to remove the last of Betsy's surge from New Orleans.[653]

No floodwaters reached west of the Esplanade Ridge. The French Quarter, CBD, Uptown, Lakeview, urbanized Jefferson Parish, and the West Bank all endured only wind damage, though that too was extensive. Tens of thousands of homes suffered structural damage; historic churches lost steeples; old homes toppled by the score; and nineteenth-century roofing slate littered the streets of the French Quarter.

Hurricane Betsy and its flood claimed the lives of eighty-one Louisianians, injured 1,500, and caused $372 million 1965-value dollars in damage, about one-third in New Orleans proper. Its greatest cost, however, came in the form of unlearned lessons. As part of the Betsy-inspired Lake Pontchartrain and Vicinity Hurricane Protection Project, federal, state, and local efforts proceeded to build levees around the basins flooded by Betsy, expand residential developments into them, augment the very canals that ushered Betsy' surge inland, and build levees to standards that Betsy demonstrated to be obsolete.

Hurricane Katrina would reveal the folly of this effort forty years later, demonstrating a truism long recognized by hazard planners: the aftermath of one disaster becomes the prelude to the next.

Louisiana's Dilemma

Coastal erosion and challenges of reversing it

Louisiana has lost over 2,000 square miles of coastal wetlands—about one-third of the Louisiana deltaic plain—since the 1930s. Twenty-five to thirty-five square miles of marsh disappeared annually during the 1970s-80s, a pace of loss well over twenty times swifter than the Mississippi River took to build the wetlands in the previous 7,200 years. The rate slowed somewhat in the 1990s-2000s, not because the problem had been partially solved but because so little land was left to lose. Five interrelated factors drive coastal erosion.

First, the control of the Mississippi through the construction of artificial levees has starved the deltaic plain of annual deposits of replenishing freshwater and flood-borne sediments. Second, an extensive network of navigation, oil and gas, and drainage channels increased the extent of land/water interfaces and saltwater-intrusion routes, and thus opportunities for erosion and swamp die-off. Their attendant guide levees and spoil banks served to channelize storm surges and impound saltwater. Third, soils drained of their water content, through municipal drainage or flood control, subside under their own weight (see *"Smile: Your House Is Sinking"*). Fourth, gulf waters are gradually rising, as global temperatures increase and ice sheets melt. Finally, the dying of coastal saltwater marsh grasses ("brown marsh"), destroyed by invasive nutria, salinity, or droughts, renders the dwindling land surface even more vulnerable to wind and water erosion. Geological faults and petroleum extraction may also play roles.

Human agency initiated these processes (some of which occur naturally to varying degrees) in the 1700s and 1800s, and accelerated them perilously in the 1900s with the emergence of modern river control, marsh reclamation, urban drainage, canal excavation, the petroleum industry, and fossil fuel consumption. Debate rages in the scientific community as to whether levee construction of the Mississippi, or the excavation of navigation, oil, and gas canals, weighs more heavily in the coastal erosion equation. The stakes are high, because which factor proves more influential informs on who should foot the restoration bill. Most scientists agree that if current trends continue, the Louisiana deltaic plain will be mostly gulf water by the twenty-second century.

Coastal erosion makes New Orleans more vulnerable to hurricanes because approximately every 2.7 linear miles of wetland loss allows one extra vertical foot of seawater to surge inland in the face of a tropical storm. Some researchers put the ratio at one mile to one foot. The coastal land loss from hurricanes Katrina and Rita in 2005 totaled well over 200 square miles throughout southern Louisiana, or roughly ten years' worth of loss in two days. Worse yet, the loss was not proportionally distributed: nearly half came from the relatively small land area east of the lowermost Mississippi River, the buffer needed most for the protection of metropolitan New Orleans. In some areas,

particularly the upper Breton Sound Basin around Lake Leary, nearly a half-century of erosion transpired in a matter of hours.

There is hope; this is a solvable problem. River diversions, siphons, crevasses, and "third deltas" must be deployed to re-create the historical tendency of the Mississippi to overflow and replenish the coastal wetlands with fresh water and sediment without the deleterious effects of flooding. The Caernarvon (1991) and Davis Pond (2002) diversions have been successfully pushing back the saltwater wedge and creating some new land in the receding wetlands. Caernarvon in particular serves the very area that suffered the most intense land loss during Katrina and Rita. The 2005 storms were not all bad for the coastal region: their surges mobilized offshore sediments and pushed them upon the wetlands, substantiating them in some areas.

Additional massive river diversions and uncontrolled crevasses are needed, but unfortunately, they will fall short of saving the coast. The reason was alluded to in historical documents. Former French governor Soniat du Fossat reported in 1791 that, as the "extremely muddy Missouri" River joins the Mississippi, "the earthy substance contained in these waters" produces a "deposit … about one third of the volume of the water taken."[654] Christian Schultz wrote in 1810 that "the turbidness of the [Mississippi's] water is such as to prevent any thing being seen at a depth of six inches [enough to] deposit a sediment of half an inch deep in a half pint tumbler…"[655] Joseph Holt Ingraham reported in 1835 that "a glass filled with [the Mississippi's] water appears to deposit in a short time a sediment nearly equal to one-twelfth of its bulk."[656] If one were to repeat these experiments today, a film of sediment immeasurably thin to the naked eye would settle to the bottom of the glass—revealing yet another very serious problem for the future of coastal Louisiana. Sediment levels in the river today are 60 to 80 percent lower than in historical times, because numerous dams and locks built upriver and on the sediment-bearing western tributaries since World War II have trapped vast quantities of the less suspended-sediment load (sand), while remaining particles spill out uselessly as bedload on the continental shelf. A levee-constrained river bearing less sediment means the river's land-building capability is handicapped even if diversions and crevasses are opened. To patch the shortfall, sediment-mining operations are needed locally to deliver this valuable resource from the river's bedload, or from offshore deposits, onto the fraying coastal wetlands. Dredging barges, siphons, diversions, and crevasses must be situated to disperse the sediments across the wetlands and fertilize them with the river's nutrient-rich fresh water.

Then there is the universal problem of global warming. While sea-level rise threatens levee-encircled New Orleans as it does all coastal cities, it does not necessarily spell doom for the Louisiana coastal region on which New Orleans depends. Unlike other areas, Louisiana possesses a valuable tool to fight sea-level rise: the Mississippi River and its ability to build land. River diversions and sediment siphoning, if done at the requisite magnitude, can build up coastal marshes even upon rising seas. It's happened before: the entire Louisiana deltaic plain formed during a time of warming temperatures and rising seas. The current pace of rise, however, is troubling, as is the dearth of riverine sediments and the slow bureaucratic process behind major restoration projects.

Hurricanes Katrina and Rita convinced many scientists and managers that radical solutions are needed within the next generation if coastal Louisiana and New Orleans are to survive. Diverting the Mississippi to create a new bird's foot delta in the Breton Sound, once the fantasy of extremists, is now recommended publicly by many experts.

Decisions of this magnitude may spell death for some of the very cultures and landscapes—namely, in lower Plaquemines Parish—they are intended to save. Consider Louisiana's dilemma: What constitutes a culture worth saving? Worth sacrificing? How do we ask people who have lived sustainably off the land for generations to relocate, so that a city dweller may enjoy greater environmental security?

Then again, should we threaten the safety of a million people for the sake of a thousand?

"Smile: Your House Is Sinking"

Soil subsidence in the New Orleans metropolitan area

River-deposited sediments occupy a volume bloated by water content. If the water drains away, organic matter disintegrates and crevasses open up, allowing particles to settle into the new air spaces and the soil body as a whole to become denser and more compact. The result: subsidence, the lowering of the elevation of a land area in relation to sea level."[657] A natural process in a deltaic plain, subsidence is normally counterbalanced by incoming deposits of sediment-laden floodwaters, made at roughly the same pace. Deltaic regions maintain topographical equilibrium so long as the sustaining river does not meander away or otherwise cease to replenish its flanks.

Or so long as man does not intervene by constraining the river with artificial levees, which prevent inundation but also restrict new sedimentary deposits to the deltaic bank account. This is what has happened in southeastern Louisiana. New Orleans' topographic elevation is presently diminishing, in absolute terms and particularly in relation to sea level, which, in a conspiracy of factors partially of man's own doing, happens to be rising at increasing rates.

The prehistoric New Orleans landscape, unlike the cityscape today, lay *at* or *above* sea level; its lakeshore and eastern marshes communicated with saline water while interior ridges and natural levees rose five to fifteen feet above it. If any substantial areas lay below the level of the sea, they would inundate immediately to form tidal lagoons. Even as New Orleans developed, its urbanized surfaces remained almost entirely above sea level into the late nineteenth century. Period photographs of people recreating along the unleveed Lake Pontchartrain shore confirm this little-appreciated fact, as do nineteenth-century topographic maps and an 1853 account by visiting

French geographer Elisée Reclus:

> The districts far from the Mississippi are only a few centimeters above sea level, and people's homes are separated from alligator nests only by drainage pools of stagnant and always iridescent water.[658]

Twentieth-century levee and drainage manipulations subsequently allowed about 30 percent of the urbanized land surface to drop below sea level by 1935.[659] By century's end, that figure hovered around 50 percent; worse yet, those areas already below sea level had subsided further. An analysis of 1994 GPS elevation data indicates that the levee-protected terrestrial surfaces of Orleans Parish, from the Jefferson Parish line to the eastern hurricane-protection levees plus Algiers, are 53 percent at or above sea level, and 47 percent below. (The unprotected eastern marshes are mostly at or slightly above sea level.) Results are similar for the metropolitan area. circa-2000 LIDAR ("light detection and ranging" laser remote sensing technology) elevation data show that 51 percent of the terrestrial surface of the contiguous urbanized portions of Orleans, Jefferson, and St. Bernard parishes lie at or above sea level (with the highest neighborhoods ten to twelve feet above sea level), while 49 percent lies below sea level, in places to equivalent depths.[660] The "districts far from the Mississippi" that Elisée Réclus visited in 1853—probably today's Gentilly or Lakeview—now lie over eight feet below sea level in some areas.

Subsidence is not an arcane scientific preoccupation in New Orleans; it is a topic of everyday conversation. It became a household word during the oil-boom years of the 1970s, when rapid urbanization of recently drained Jefferson Parish resulted in widespread foundation and structural damage (including house explosions from severed gas lines) and landed the issue repeatedly in local news. Headlines tell the story of an unfurling environmental problem and a society grappling to adapt to it: "Rats, Nutria, Snakes, and Mosquitoes—Not to Mention Sinking Backyards" (1974), "Seeking Solutions to Kenner's Soil Subsidence" (1977), "Smile: Your House Is Sinking" (1977), "Soil Sinkage Plagues 64% of West Jeff" (1978), and "New Law Requires Pilings" (1979).[661]

Recent studies have calculated average subsidence rates of five to ten millimeters per year in and near the metropolis, and over double that rate at the bird's foot delta of the Mississippi.[662] Although its metropolitan effects—sunken corners of yards, buckled streets, cracked and leaning buildings—are visible to the eye, subsidence is difficult to measure precisely within cities because of its subtlety, complex causes, and high spatial variability. Factors including "geology, soils, hydrology, well locations and water withdrawal … levee locations, drainage pumping station sites … the history of drainage and settlement, application of fill and overburden, the bulk and density of buildings, [and] land use" all influence rates at any given spot.[663] Micro-scale subsidence measurements may thus vary widely with seemingly little rhyme or reason: some sites in the high-elevation CBD, for example, have paradoxically subsided faster in recent years than certain low-lying spots in Metairie and New Orleans East. However, the general rule is that higher-elevation lands with coarser soil particles and less organic matter

subside at slower rates than low-lying former marshland with finer soil particles, higher water tables, more organic matter, and a more recent artificial-drainage history. Within the metro area, rates vary from two to three millimeters per year on the higher natural levees developed in historical times, to over ten millimeters annually in low-lying suburban subdivisions built on marsh soils and drained more recently.[664]

Comparison of circa 2000 LIDAR elevation data with nineteenth-century topographic maps helps capture the overriding trends and patterns of soil subsidence in New Orleans. Most historical efforts at elevation mapping were simply too limited, approximated, or inaccurate to be of any quantitative use today. There is, however, one exception. In 1893, the City Council directed the Engineering Committee of the Drainage Advisory Board to design a major pumping system to solve New Orleans' age-old drainage problem. Over the next two years, W. C. Kirkland and his staff, under the direction of city engineer L. W. Brown, ran hundreds of topographic surveys, tabulated the data, plotted one-foot contours on a detailed street network at a cartographic scale of one-inch-to-600-feet, and produced in 1895 ten large linen maps under the title *Topographical Map of New Orleans*.[665] The effort covered the heart of Orleans Parish, excluding rural areas east of Peoples Avenue and the Lower Coast of Algiers. Because the contours were based on the Cairo Datum, a now-obsolete cartographic standard calculated at the time as 21.26 feet above the mean level of the Gulf of Mexico, the Kirkland-Brown-E.A.B map shows elevations ranging from thirty-seven feet (15.74 above sea level) at the foot of Canal Street, to twenty feet (-1.26 below sea level) in present-day Mid-City. Adjusting for this vertical-datum difference allows for comparison to modern elevation data with respect to the levels of the sea which existed at the time. (Sea level has risen by roughly 7.7 inches since the late nineteenth century.[666])

The results are stunning (see map, "A Century of Soil Subsidence in New Orleans"). The natural levee of the Mississippi, measured from Claiborne Avenue to the river, subsided from an average of 5.1 feet above sea level in 1895 to 4.1 feet in 2000, while the Metaire/Gentilly/Esplanade ridge systems dropped from an average of two feet above sea level in 1895 to 0.76 feet in 2000. The basin (present-day Broadmoor and Mid-City, for example) between the river's natural levee and the ridge systems sunk from three inches below sea level in 1895 to 1.8 feet below sea level in 2000, while the former lakeside marshes now comprising neighborhoods such as Lakeview and Pontchartrain Park subsided from the level of the sea in 1895, to 4.4 below the sea on average in 2000. The mile immediately south of the original lakefront (present-day Robert E Lee Boulevard)—areas of fine-y textured, high-humus soils which once had a high water table—have subsided the most, by six to eight feet in one century.[667] Certain spots of urbanized New Orleans East (not included in this analysis) have dropped by nearly *double* that depth—in about *half* the time.

At the structural level, subsidence is an expensive nuisance. The mandated use of pilings for new construction in certain areas, the recommended use of flexible utility connections, and artificial fill by the truckload counter the worst effects of the phenomenon, but the problem itself may be unsolvable within urbanized areas. Homeowners respond by shoring up their raised houses with jacks and pilings, or, more desperately, watering the underlying soil with a garden hose during dry spells. Greater New Orleans

is home to more shoring specialists per-capita than any other major American city; one, Abry Brothers, has been in business since the 1840s.

At the regional level, subsidence is deadly. Drainage-driven soil sinkage in collusion with levee construction transformed New Orleans' topography from a slightly above-sea-level plain interspersed with higher ridges, to a series of bowls half above and half below sea level, surrounded by high brims. When some of those brims breached during Hurricane Katrina, the water-trapping capacity of a hundred years' worth of subsidence helped turn a natural disaster into an unnatural catastrophe.

Hurricane Katrina

Paying the piper

> [...awoke by the noise of the doors and windows violently agitated by the wind; it increased to the hurricane roar, lulled, and rose again, and blew with appalling force from the opposite point of the compass, rain at the same time deluging the city.

> [Then] the sea rushed into Lake Pontchartrain [and] burst its banks, and the city was under water, the Levee only being dry... Many houses were unroofed, and almost all damaged ... many lives were lost ... the unburied dead were laid in their coffins in the grave yard, and floated about till the waters subsided[;] the stench was horrible.

> [T]his leads me to believe that one day this city, rapidly increasing as it is in wealth and consequence, will be swept into the Gulf of Mexico, if the Mississippi happen to rise [while] the south-east wind raises the sea .... [668]

— Scottish visitor Capt. James Edward Alexander, New Orleans, September 1, 1832

On Tuesday, August 23, 2005, a tropical wave fueled by unusually warm ocean water spiraled in an upward counterclockwise direction over the southeastern Bahamas. The westward-edging column of low pressure sucked increasing quantities of heated air into the system, growing it sufficiently for the National Hurricane Center to classify it as Tropical Depression 12, and by the next morning, as Tropical Storm Katrina. By late Thursday afternoon, Category-1 Hurricane Katrina approached the metropolis of southern Florida with 75 mph winds. The system and its torrential rains killed nine people in the north Miami area overnight, then, surviving the jaunt over the Florida peninsula, entered the Gulf of Mexico.

Although the 2005 hurricane season had been accurately predicted as an extraordinarily busy one, tropical activity had disarmingly abated during July and August,

and most New Orleanians only passively took note of the seemingly weak and distant storm. But awaiting Katrina in the gulf was a gigantic source of storm fuel: a loop current of deeply layered warm water, pulsating in from the Caribbean between Cuba and the Yucatan and breaking off into eddies through the Gulf of Mexico before exiting into the Atlantic between Cuba and Florida. With sea surface temperatures around ninety degrees and more warmth below, a system that made it into the gulf at this particular time would strengthen dramatically without the reprieve of cooler sub-surface waters.

Computer models at first forecasted storm tracks up the Florida peninsula, then westward over the panhandle, then further westward to the Alabama border, where so many storms had landed during the recent ten-year surge in tropical activity. The farther west Katrina crept, the more energy it drew from the warm loop current, and the more seriously it threatened gulf coastal communities.

Many schools and offices closed down in New Orleans on Friday afternoon, most conversations and email communications concerned weekend plans and next week's meetings, not evacuations and possible closures, much less regional calamity. It was not until that evening, by which time the forecast tracks started pointing to the Louisiana/Mississippi border and Governor Kathleen Blanco declared a state of emergency, that citywide attention turned to the heightening threat.

KATRINA PUTS END TO LULL;
STORM'S WESTWARD PATH PUTS N.O. ON EDGE
—*Times-Picayune* headline,
Saturday, August 27, 2005

With Katrina a strengthening Category-3 storm and the notoriously divergent computer models now all ominously converging on a Louisiana landfall, the central Gulf Coast population finally mobilized on Saturday. Emergencies were declared at the state level in Mississippi and federal level in Louisiana, something rarely done before a disaster strikes. Officials activated the complex "contraflow" evacuation plan, allowing motorists to utilize incoming interstate lanes to flee the New Orleans metropolitan area. Many departed Saturday; more left Sunday, August 28, when the system strengthened to Category-4 and Category-5 levels within five hours.

KATRINA TAKES AIM
—*Times-Picayune* headline,
Sunday, August 28, 2005

By late Sunday morning, with Katrina's winds hitting 175 m.p.h., nearly all qualified observers were certain of a New Orleans-area landfall. Mayor C. Ray Nagin ordered a mandatory evacuation of the city, though no one seemed to know exactly what that meant and many could not comply even if they wanted to.

The evacuation window had all but closed by Sunday night, as the initial feeder bands whisked over the city; the only choices now were to "ride it out" at home or take refuge in the Superdome. Roughly 100,000 New Orleanians—one in every four to five—remained in the city, and of those, approximately 10,000 lined up outside the

Superdome, expecting at least a safe if uncomfortable night. A solemn and profoundly troubled air prevailed among the reporters and authorities on the local news stations that evening. No one could believe that the proverbial Big One, the topic of endless planning scenarios and stern authoritative admonitions, the butt of countless doomsday jokes and glib clichés, was finally upon us, all within a weekend.

Overnight, Hurricane Katrina's low barometric pressure and high winds sucked up a dome of gulf water and blew it northward into the Mississippi Gulf Coast and Louisiana deltaic plain. Under natural conditions, hundreds of square miles of wetlands would have absorbed or spurned the intruding tide. But a century of coastal erosion cost the region precious impedance, while a labyrinth of man-made canals served as pathways for the surge to penetrate inland. A "funnel" formed by two mid-twentieth-century navigation canals—the Intracoastal Waterway (ICWW) and the Mississippi River-Gulf Outlet (MR-GO) and their respective guide levees—allowed Katrina's surge to swell waters in the circa-1920 Industrial Canal transecting the very heart of the New Orleans metropolis.

GROUND ZERO

SUPERDOME BECOMES LAST RESORT
FOR THOUSANDS UNABLE TO LEAVE
NEW ORLEANS BRACES FOR NIGHTMARE OF THE BIG ONE

—*Times Picayune* headline,
Monday, August 29, 2005

At 4:30 a.m., August 29, with Hurricane Katrina a few miles offshore, canal water seeped through flood gates near Chef Menteur Highway. Minutes later, the tide in the funnel overwhelmed the guide levees of the MR-GO and rushed southward to within a few hundred feet of residential neighborhoods in the Lower Ninth Ward and St. Bernard Parish. The same thing happened around 6 a.m. to the guide levees along the Intracoastal Waterway to the north, and thirty minutes later, the surge inundated low-lying New Orleans East and its vast acreage of circa-1970s subdivisions.

Hurricane Katrina made landfall at 6:10 a.m. over Louisiana's Barataria Basin, between Grand Isle and the mouth of the Mississippi. The eye's center passed over the river towns of Empire and Buras, then the eastern St. Bernard Parish community of Hopedale, about twenty-five miles east of downtown New Orleans. The towering mass of storm clouds spanned from central Louisiana to western Florida; the outermost feeder bands stretched from the Texas hill country to the Georgia coast, from the Yucatan to the Appalachians.

Although wind speeds had abated to Category-2 levels, Katrina's storm surge retained the momentum of the earlier Category-5 status. Gulf waters swelled ten to thirty feet above normal sea level, inundating 200 miles of coastline across four states. Lake Pontchartrain's waters swelled to almost nine feet above normal, while the Mississippi River, which gauged at a typically low late-summer stage of about four feet above sea level, rose to nearly seventeen feet and spilled over laterally in lower Plaquemines Parish.

In New Orleans, the front line of the unraveling drama was the Industrial Ca-

nal, where turbulent waters rose to twelve, thirteen, fourteen feet above normal level. Pressure built upon layers of soft, organic marsh soils beneath the modest levees, while thin floodwalls anchored with insufficiently deep sheet pilings leaned landward with the weight of the water column. The first failure occurred at 6:50 a.m. on the western side of the canal, flooding the Florida Avenue corridor through the Upper Ninth, Eighth, Seventh, and Sixth wards. Then, at 7:45 a.m., a catastrophic failure on the eastern side of the Industrial Canal sent a torrent of water from a level of fourteen feet above sea level into adjacent blocks of the Lower Ninth Ward that lay as low as four feet below sea level. The violent rapids joined with other waters simultaneously overtopping the rear levee from the north, and a third source entering from the east via Bayou Bienvenue. By 8:30 a.m., nearly the entire Lower Ninth Ward of Orleans Parish plus Arabi, Chalmette, and Mereaux in adjacent St. Bernard Parish had drowned at a pace of ten feet of water within twenty minutes. Residents perished by the score.

The front line of the catastrophe then began to shift from the navigation-canal failures on the eastern edge of the metropolis to the slender drainage canals scoring the northern tier fronting Lake Pontchartrain. High seas in the brackish-water lake swelled their water levels and increased pressure on the canals' thin concrete walls and porous underlying marsh soils.

At 9:00 a.m., water began entering through a neglected low spot on the Orleans Avenue Canal west of City Park. Around the same time, small breaches opened in the London Avenue Canal east of the park, one of which widened at 9:30 and began to flood the low-lying sections of Gentilly. Then, at 9:45 a.m., a major failure occurred on the 17th Street Canal, violently inundating the prosperous, low-elevation subdivision of Lakeview. Within the next hour, another major breach opened on the London Avenue Canal.

By this time, Hurricane Katrina had made its second landfall near the mouth of the Pearl River along the Louisiana/Mississippi border. The Mississippi Gulf Coast towns of Waveland and Bay St. Louis, positioned in the northeastern quadrant of the track, bore the full strength of Katrina's 125+-mile-per-hour winds and twenty-nine-foot storm surge. Biloxi's surge measured the highest ever recorded in America. Neighborhoods within a half-mile of the beach were wiped off the face of the earth within minutes. In New Orleans, winds peeled off the white surface coating of the Superdome and broke two six-foot holes in the roof, terrifying the thousands of frightened refugees within the darkened and sweltering interior. Denizens of higher ground who rode out the storm at home experienced the same moment-to-moment apprehension of winds rocking their houses and rattling roofs, windows, and doors. What none realized, of course, was that their fellow citizens on lower ground faced not only these same fierce gusts, but also deadly rising water.

The southern Mississippi landmass deprived Katrina of its warm-water fuel source, weakening the system to tropical-storm levels as it pushed inland, but not before it buffeted the southern half of the state as well as the eastern Florida parishes of Louisiana. Winds, now from a westerly direction, died down by late afternoon in New Orleans.

Many journalists, overly focused on Katrina' east-of-the-city track and dimin-

ishing intensity, mistakenly reported Monday afternoon that New Orleans, as the infamous cliché had it, "dodged the bullet." Many residents, evacuated and otherwise, went to bed prepared to return home, pick up the branches, fix the roof, and resume their lives. It was not until Tuesday that they learned a jolting new truth—one that, in fact, was as old as the city itself: the flood-protection and drainage system had *not* neutralized topography and hydrology; New Orleans' ancient geographies of risk, supposedly subjugated by technology a century ago, came rushing back to life. The various hydrological sub-basins comprising the New Orleans bowl were filling up.

CATASTROPHIC

STORM SURGE SWAMPS 9TH WARD, ST. BERNARD;
LAKEVIEW LEVEE BREACH
THREATENS TO INUNDATE CITY

—*Times-Picayune* headline,
Tuesday, August 30, 2005

Social unrest developed among the trapped, thirsty, hungry citizenry. Looting, sometimes out of genuine need for food and water, other times for opportunistic thievery or sheer vandalism, became so rampant that already overwhelmed police chiefs and politicians generally paid it lip service or ignored it entirely. Officials called for the immediate evacuation of the tens of thousands of people who remained in the city, but no mechanisms were in place to do so, nor were any immediately on the way. Crowds of the poorest citizens, which numbered about 10,000 in the Superdome Sunday night, swelled to as many as 45,000 at the damaged stadium and at the Morial Convention Center, both of which were completely unprepared for the crush. Scenes stereotypical of Haiti or Bangladesh, with all the ugliest connotations, played out in downtown New Orleans and were broadcast worldwide. Elderly, the infirm, and children suffered the most; some youths exploited the chaos, looting, brawling, and shooting at rescue workers.

UNDER WATER

LEVEE BREACH SWAMPS CITY FROM LAKE TO RIVER;
POPULATION URGED TO LEAVE; YEARS OF CLEANUP AHEAD

—*Times-Picayune* headline,
Wednesday, August 31, 2005

Efforts to plug the 17th Street Canal breach with helicopter drops of sand failed utterly. Only when Lake Pontchartrain's high waters drained sufficiently back into the Gulf of Mexico on Wednesday and Thursday did water cease entering the city, allowing for the makeshift repair of the levees.

With Katrina's winds long gone and the floodwaters no longer rising, New Orleans now grappled with a new crisis: social disintegration. Police had to be called off search-and-rescue missions to control pillaging and chaos. Stranded crowds suffering deplorable conditions at the Superdome and later the Convention Center started making their way up exit ramps and onto interstates and bridges, in search of any alternative to the hell below. The line between victim and perpetrator blurred in the eyes

of over-stressed authorities, occasionally leading to ugly confrontations and injustices. Buses to evacuate the desperate masses were few and slow in coming; the very first were able to depart for Houston on Wednesday. The shocking spectacle of a modern First World society coming apart at the seams, within the borders of the wealthiest and most powerful nation on earth, was broadcast as lead story worldwide, repeatedly, for days and weeks.

HITTING BOTTOM
THE WATER HAS FINALLY STOPPED POURING IN BUT IT
COULD BE OCTOBER BEFORE THE CITY DRIES OUT
—*Times-Picayune* headline,
Thursday, September 1, 2005

Crises begin to multiply and intensify; what started as a disaster that turned into a catastrophe was now starting to look like an apocalypse. Bandits and authorities engaged in shoot-outs from streets and rooftops. Gas bubbled up from floodwaters and burned like a scene in hell. Fires broke out citywide, which firefighters could neither reach nor douse. An anguished Mayor Nagin, his city at the darkest moment of its history and seemingly abandoned by the nation, issued a now-famous "desperate S.O.S." to the world via an emotional interview on WWL radio. "Don't tell me 40,000 people are coming here," he raged; "they're not here. It's too dog-gone late. Now get off your asses and do something, and let's fix the biggest goddamn crisis in the history of this country!" Federal responses in the form of armed troops, supplies, buses, medical attention, and most importantly, communication and coordination, finally began to trickle in late Thursday. It would take a full two to three days before they could stabilize the degenerative human conditions in the ravaged city (80 percent of which was under water), and evacuate the stranded to Houston or elsewhere.

"HELP US, PLEASE"
AFTER THE DISASTER,
CHAOS AND LAWLESSNESS RULE THE STREETS
—*Times-Picayune* headline,
Friday, September 2, 2005

By this time, pundits and the national press started to remark openly about what had been silently obvious to all viewers: the vast majority of the people stuck in the cauldron of the calamity were poor and black. A national conversation, conducted in tones ranging from cautious explanation to righteous indignation, ensued about race, poverty, history, and New Orleans society. The disaster-turned-catastrophe-turned-apocalypse was now becoming a troubling commentary about America.

FIRST WATER, NOW FIRE
BLAZES TURN PARTS OF BESIEGED CITY
INTO AN INFERNO
—*Times-Picayune* headline,
Saturday, September 3, 2005

The "lost September" of 2005 will be remembered by New Orleanians, scattered nationwide and humiliatingly dependent on the kindness of strangers, as among the most difficult times of their lives. Unknowns haunted every aspect of life, from food, clothing, and shelter in the near term, to the whereabouts of loved ones, to housing, finances, education, and employment in the long term. Backdropping this angst was the greatest unknown of all: the very survival of the metropolis. Once among the most diverse and colorful assemblages of humanity on the continent, regularly predicted to rank among the world's great cities, New Orleans in September 2005 stewed in its own filth, empty, broken, moldy and silent.

HELP AT LAST

AFTER FIVE DAYS, THOUSANDS OF ANGUISHED STORM VICTIMS FINALLY HAVE A REASON TO HOPE

—*Times-Picayune* headline, Sunday September 4, 2005