A f t e r t h e W a t e r R e c e d e s :

Recovering Flood-Damaged Parking Structures

Managing electric vehicles, structural conditions, and critical building systems after a flood

After the water recedes

When floodwater fills a parking structure, the loss rarely stays in one place. The water touches the cars, and it also touches the concrete that holds them, the switchgear that powers the lights, the chargers along the walls, the sump pumps in the lowest bay, the ventilation fans, the elevator pit, the fire alarm panel, and the gate arms at the entrance. By the time the water drops back below the ramp, every one of those systems has a question mark over it. A parking structure is a single connected machine, and a flood reaches all of it at once.

That is the reason this recovery is harder than it looks. Extraction crews arrive, pumps run, the standing water disappears, and the deck looks passable again. Water extraction is the start of the technical recovery. It is not the finish. What the water leaves behind, chloride residue on a bus bar, silt in a pump volute, saturated insulation inside a motor, corrosion starting on reinforcing steel, is what actually determines whether the facility is safe to reopen and what it will cost to get there.

This paper is written for the people who have to make those calls: commercial property adjusters, major-loss and complex-claims teams, property owners and facility managers, risk managers, restoration and recovery contractors, parking operators, and the towing and vehicle-recovery firms that move the cars. It looks at three connected parts of the loss: the flooded vehicles, the concrete structure and the loads placed on it during recovery, and the critical building systems that make the structure usable. The central message runs through all three. Vehicle, structural, and equipment decisions have to be coordinated, because a decision made in isolation on one can quietly transfer risk onto another.

Flood-exposed electric and hybrid vehicles

A modern electric or hybrid vehicle carries a high-voltage battery, usually a sealed pack mounted low in the floor, made up of hundreds or thousands of individual lithium-ion cells. Even a vehicle that is dark, silent, and apparently dead still holds energy in that pack. The industry calls it stranded energy: charge trapped in cells that have been damaged or isolated without being fully discharged. Stranded energy is why a flooded EV that will not power on is not, by that fact alone, electrically safe.

Water changes the picture in ways that depend on the water. Fresh water is the least aggressive, though it still carries silt and contaminants into places they should not be. Contaminated fresh water adds sewage, fuel, and chemicals. Salt water is the worst case. Salt residue is both conductive and corrosive, and it does not leave when the water leaves. It stays on the battery casing, the connectors, the low-voltage harness, and the charging hardware, and it keeps working. Teardown examinations of seawater-flooded EVs recovered after Hurricane Ian found distinct corrosion throughout the vehicles, on pack exteriors, low-voltage systems, and high-voltage charging connectors, along with measurable charge still present in packs many months after the flood. That conductive residue can bridge connections that were never meant to be bridged, and the resulting short can develop into a fire once the vehicle is out of the water and drying.

This is where the fire framing has to stay honest. Not every flooded EV will ignite. Most do not. The teardown work above examined ten survived vehicles and found that the water intrusion, in those cases, was not enough to cause catastrophic battery damage. At the same time, some flooded vehicles have caught fire after exposure, including incidents tied to towing and storage rather than the flood itself. Both things are true, and an adjuster or facility manager should hold both. The risk is real, it is manageable, and it does not justify treating a parking deck full of flooded EVs as a field of certain fires.

Delayed response is the part that surprises people. Thermal runaway, the rapid self-heating chain reaction inside a damaged cell, can begin hours or even days after the water is gone. A vehicle can sit quietly through extraction, get loaded onto a flatbed, and only then begin to vent or ignite. That delay is why the absence of visible warning signs, no smoke, no odor, no heat, does not establish that the battery is sound. It establishes only that nothing is happening yet.

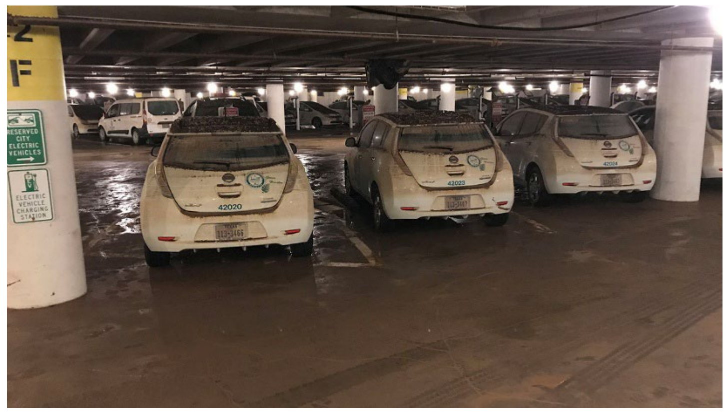
Because of that, judgment about any specific vehicle has to come from the manufacturer. Battery chemistry, pack location, disconnect procedures, and post-submersion guidance differ from brand to brand, model to model, and year to year, and there is no universally accepted, scientifically validated method that safely covers all of them. NHTSA maintains manufacturer-submitted emergency response guides and rescue sheets that address fire, submersion, leakage, towing, and storage for specific vehicles. Those documents, and direct contact with the manufacturer, are the right basis for handling decisions. General rules of thumb are not. It is worth noting that the fire research community is still filling gaps here; recent Fire Protection Research Foundation work on modern vehicles in parking structures continues to study sprinkler hazard classification, fire spread between vehicles, and the conditions that produce worst-case vehicle-fire scenarios.

For an adjuster, the practical takeaway is that a flooded EV is a managed hazard with a clock on it, not a settled total. It needs identification, documentation, and model-specific handling before anyone decides what happens to it.

Identifying, documenting, moving, and storing flooded vehicles

Good decisions on flooded vehicles start with knowing exactly what each one is. That means capturing the manufacturer, model, model year, VIN, and powertrain, gasoline, hybrid, plug-in hybrid, or battery-electric, before anything moves. The powertrain determines the hazard, and it is not always obvious from the badge.

Alongside identity, the exposure needs a record. Water depth against the vehicle, how long it sat submerged, whether it was charging at the time, and the type of water all shape the risk and the eventual valuation. Prior collision or underbody damage matters too, because a pack that was already compromised before the flood behaves differently from one that was intact. High-water marks, photographs, video, and the vehicle's position in the structure should be documented while the evidence is still there. On a claim that may later be examined in detail, the record made in the first days is often the most valuable thing anyone produces.



Movement is where handling and documentation meet. The manufacturer's emergency response guide should govern how a given vehicle is towed and lifted, including where it can be attached and which points to avoid near the high-voltage pack. Guidance from the U.S. Fire Administration is to remove potentially flooded lithium-ion vehicles from buildings and garages and to separate them from structures and combustible materials by 50 feet on all sides. NHTSA applies comparable separation guidance to a severely damaged lithium-ion vehicle. Those are the agencies' stated thresholds, and they should be applied as written rather than blended together.

One decision deserves to be made before the tow truck arrives: where the vehicle is going. Identifying the receiving location first prevents the most common mistake in EV recovery, which is relocating the exposure from one enclosed building into another. A flooded EV moved from a parking deck into a closed storage garage has not been made safer; the hazard has simply been given a new roof. Separation and storage planning, open air where possible, spacing between vehicles, and distance from anything that can burn, should be settled up front, not improvised at the curb.

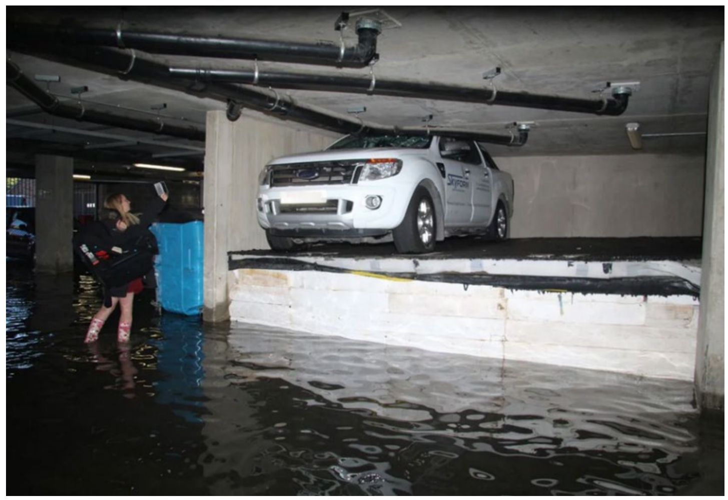
Handled this way, vehicle recovery becomes a controlled sequence: identify, document, plan the destination, then move. Each step protects the people doing the work and protects the claim record that everyone will rely on later.

The concrete structure and the loads recovery places on it

The concrete did not leave when the cars floated. During the flood, the structure takes hydrostatic pressure from standing water and hydrodynamic force from water in motion, and in below-grade parking those pressures do not balance evenly across a wall or slab. Trapped and floating vehicles add their own loads. After Hurricane Sandy, damage investigators noted minor structural damage where floating cars struck decks and columns, and trapped cars exerted uplift on submerged parking decks. Debris carried by the water adds impact on top of that.

What the water leaves is a set of conditions a structural engineer has to read. Cracking, spalling, displacement, and delamination can all follow flood exposure, and where reinforcing steel is exposed it becomes a direct path for corrosion. The larger long-term concern is chloride. Salt-bearing water drives chloride ions into concrete, and once the concentration at the reinforcing steel passes a threshold, corrosion can proceed on its own, expanding the steel, cracking the surrounding concrete, and reducing the section that carries load. This is the mechanism behind the Champlain Towers South collapse, where the National Construction Safety Team found punching-shear failures at slab-to-column connections and loads that redistributed to adjacent connections not strong enough to carry them, with long-term corrosion among the contributing factors. A parking deck is not a residential tower, but the physics of chloride-driven corrosion and load redistribution are the same, and they are why flood-exposed concrete deserves a real look rather than a glance.

Where fire or localized heat has occurred, from a vehicle that ignited during or after the flood, that exposure has to be assessed as its own condition, because heat changes concrete and steel in ways water does not.



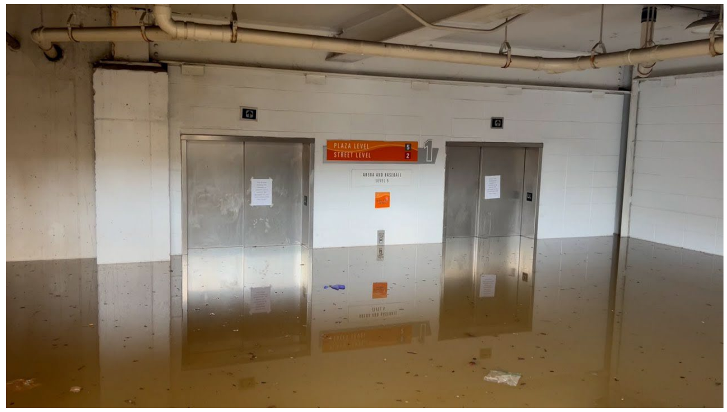
Car crushed by buoyant force of floating insulation in flooded parking garage

Nondestructive testing has a real place here, and it has limits worth stating plainly. Methods such as half-cell potential mapping, ground-penetrating radar, and chloride sampling can locate active corrosion, map reinforcement, and quantify chloride penetration. Each of them answers a specific, limited question. Half-cell potential indicates the probability of corrosion activity; it does not, by itself, give a corrosion rate or a remaining service life. No single method is a complete picture, and the reliable approach combines several and interprets them together rather than leaning on one number. Presenting any one test as proof that a structure is sound overstates what the test can do.

Then there is the part of the structural question that recovery itself creates. The equipment that clears a flooded structure is heavy. Tow trucks, forklifts, cranes, vacuum trucks, roll-off containers, and concentrated stacks of stored vehicles all place loads on a deck that may already be compromised, and they place them on a deck designed with modest assumptions. Building-code design for passenger-vehicle parking uses a uniform live load on the order of 40 pounds per square foot plus a concentrated load to represent a jack, with no allowance for tow trucks or rescue vehicles; floors intended to carry vehicles heavier than 10,000 pounds require specific design for those loads, impact, and fatigue. That gap leads to the single most important structural distinction in the whole recovery. Letting people walk back into an area is not the same decision as approving heavy recovery equipment to drive across it. The first can be reasonable while the second is still unsafe. Those two approvals should be made separately, by someone qualified to make them.

Electrical, charging, and the systems that make the structure usable

A parking structure only works because of the equipment tucked into its lowest, most flood-prone spaces. Switchboards, panelboards, transformers, feeders, disconnects, motor controls, and wiring distribute power through the building. EV chargers draw from that same distribution through a supply path that runs from the service, through protective devices and conductors, to the unit on the wall. Drainage pumps keep the lowest level clear. Ventilation and carbon-monoxide detection keep the air safe. Fire alarm and sprinkler controls protect life. Elevators move people between levels. Gates, access control, security, emergency communications, and emergency lighting keep the facility operating and safe to leave. In a flood, the water finds all of it.



Flooded Elevators at Cincinnati's East Garage

The governing principle for water-exposed electrical equipment is settled and worth stating directly: equipment that has been wet can be hazardous if it is re-energized before it is properly evaluated. NEMA's guide, Evaluating Water-Damaged Electrical Equipment, makes the point plainly, and adds the corrosion warning that matters most after a coastal flood, that saltwater residue is conductive and corrosive and keeps degrading equipment after the water is gone. The guide's other conclusions shape the whole assessment. The original manufacturer should be consulted. Some larger equipment may be professionally reconditioned by qualified people. Some equipment will need replacement outright. Testing methods have to be chosen carefully and may require manufacturer input rather than a standard checklist. The long-standing field rule captures the spirit: do not energize flooded equipment until it has been cleaned, dried, and had its insulation tested, because applying power to a wet circuit usually turns a repairable loss into a replacement.

Two traps recur in the electrical assessment. The first is water migration. Floodwater travels through conduits and raceways and collects in places the flood line never suggested, so a panel that looks dry can be fed by conductors that sat underwater, and a device mounted above the waterline can still be wet inside. The second is the assumption that working equipment is sound equipment. A charger that powers up, a pump that runs, a panel that holds voltage, none of that proves the equipment is safe, reliable, or fit for continued service. Successful energization confirms one thing on one day. It does not confirm the condition of the insulation, the contacts, or the corrosion working quietly inside.

Testing helps, as long as everyone understands what each test actually answers. Insulation resistance testing checks the integrity of insulation at the moment of the test. Functional testing confirms that a device operates. Infrared thermography can find heat where there should not be any. Each result is a data point about a specific question. None of them, alone, establishes that an entire system came through undamaged, and they should not be presented as if they do.

Flooded generator in an airport parking garage

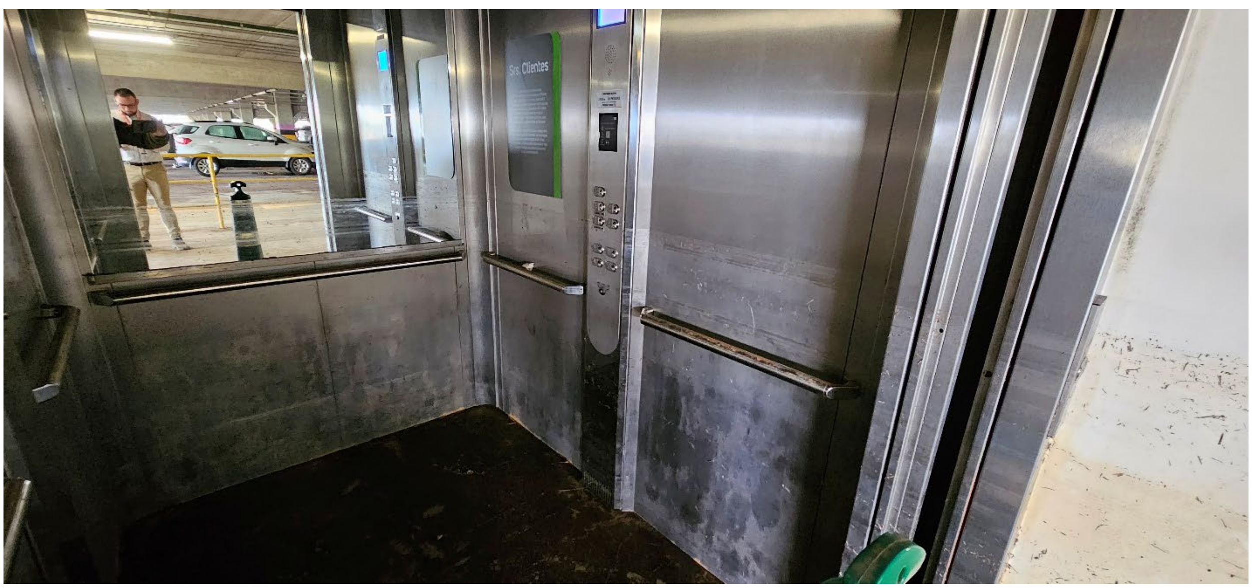
The auxiliary systems each carry their own version of the same problem. Drainage pumps and their controls are often the lowest equipment in the building and among the first to flood, which is a hard irony given that they are the equipment you most want working during and after a flood. Ventilation and carbon-monoxide detection protect people in an enclosed structure and have to be confirmed, not assumed. Fire alarm and sprinkler controls are life-safety systems, and water-exposed signaling and control equipment is generally directed toward replacement or return to the manufacturer for cleaning, recalibration, and testing rather than field repair. Elevators deserve particular attention, because the elevator pit is a sump by design and collects floodwater along with everything in it. Machine-room and pit components, controls, and wiring exposed below the flood level need evaluation, and guidance for flood-prone elevators points toward elevating controls, using float switches to keep cabs from descending into water, and treating pit equipment as flood-exposed. Access control, gates, security systems, emergency communications, and emergency lighting round out the list, and each should be tested for real function, since a gate that opens and a camera that lights up are not the same as systems a facility can rely on.

Across all of it, the reconditioning-or-replace decision follows the same logic. Consult the manufacturer, evaluate rather than assume, recondition where the manufacturer supports it and the equipment warrants it, replace where the water, the salt, or the electronics make reconditioning unwise, and test at the end to confirm rather than to hope. Warranty and service-contract terms often turn on doing this correctly, which is one more reason to document each step.

Bringing the pieces back together

None of these assessments stands alone, and the order in which they happen matters. A workable recovery moves through clear phases.

First, stabilize the site and restrict access. Before anyone evaluates anything, the structure should be secured, kept clear of people who do not need to be there, and treated as hazardous until proven otherwise.



Second, document the original conditions. High-water marks, vehicle positions, equipment locations, and visible damage should be recorded while the evidence is fresh, because this record supports every decision and every conversation that follows.

Third, screen the three exposures together: vehicles, structure, and equipment. Screening them in parallel is what keeps a decision on one from quietly creating a problem on another. The clearest example runs between the vehicles and the deck. Moving flooded EVs off the structure is the right instinct, but the tow trucks and equipment that move them may overload a deck whose capacity is already in question. Screening the structure and planning the vehicle recovery at the same time is what prevents solving the vehicle problem by damaging the concrete.

Fourth, complete the controlled work: recovery, repair, replacement, and testing, in the sequence the assessments dictate, with each system confirmed rather than assumed.

Fifth, reopen under defined conditions. A full reopening is not always the only option. A partial reopening can make sense when restored and restricted areas can be separated safely, letting an owner return part of a facility to service while work continues elsewhere. When that happens, the reopening should rest on a written plan that identifies the remaining impairments, the temporary safeguards in place, any load restrictions that apply, and who is responsible for the final work. A reopening plan that lives in writing protects the occupants and everyone who signed off on it.

The value of coordinating the recovery this way is not only safety, though safety comes first. It is also speed and cost. A recovery that sequences the work, rather than running vehicle, structural, and equipment decisions on separate tracks, avoids the rework, the transferred risk, and the surprises that show up when the pieces are handled in isolation.

Loss scope, betterment, and returning to service

One distinction deserves more weight than it usually gets. A loss-related repair scope and an owner-elected upgrade are two different things, and they should be identified separately from the start.

Flood recovery opens a structure up in ways that make improvement tempting and often sensible. With equipment already being removed, an owner may want to raise switchgear and chargers above the flood level, improve drainage, relocate chargers to better locations, add charging capacity, install flood barriers, or replace obsolete systems with current ones. Those are reasonable choices, and flood-resistant design standards such as ASCE 24 point in the same direction by calling for utilities and equipment to be placed and protected against flood loads. The technical assessment should welcome that conversation while keeping it honest. Documented flood damage is one category. Owner-selected improvements for resilience, efficiency, capacity, or future operations are another. Keeping the two clearly separated protects the owner, protects the adjuster, and protects the integrity of the claim, and it lets everyone see plainly what the flood caused and what the owner chose to add.

The through-line of this whole recovery is coordination. A flooded parking structure is one connected system, and the water reaches the vehicles, the concrete, and the equipment at the same time. The vehicles need identification, documentation, and model-specific handling, and they need to be moved without transferring their hazard indoors. The structure needs a real look at cracking, corrosion, and, above all, the difference between carrying people and carrying heavy recovery equipment. The building systems need evaluation before energization and testing that everyone reads honestly. Held together, those assessments let a facility come back safely and in the right order. Water extraction begins the recovery. A coordinated return to service, vehicles, structure, and systems decided together rather than apart, is what completes it.

Get in touch with an expert

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Amir conducts collision-reconstruction and forensic-engineering investigations involving vehicle dynamics, occupant kinematics, impact biomechanics, and vehicle-system evidence. His background includes vehicle inspection and defect investigation with Transport Canada and leadership of major collision investigations with the Ontario Provincial Police. His specialized training includes crash-data retrieval, forensic mapping, motorcycle collision reconstruction, and advanced collision reconstruction.

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Amir is an electrical engineer and equipment-loss specialist with more than 20 years of experience assessing catastrophic damage to electrical systems, mechanical equipment, and advanced energy infrastructure. His experience includes post-disaster evaluation following fires, flooding, and thermal events, with emphasis on electrical distribution, industrial controls, data centers, telecommunications, manufacturing, and energy-storage facilities. He works with equipment owners, service organizations, and original equipment manufacturers to develop testing, repair, recalibration, and replacement strategies.

About EFI Global

EFI Global is a well-established brand with an excellent reputation in the Americas, Africa, Asia-Pacific, and Europe as a market leader in environmental consulting, engineering failure analysis, and origin-and-cause investigations as well as catastrophe response. Each year, EFI Global completes more than 45,000 projects worldwide for a wide range of clients, such as commercial, industrial, institutional, insurance, government, risk managers, and public and private entities. EFI Global is one of the world's most respected emergency response firms, capable of providing practical solutions to the most complex problems following a wide range of natural and man-made disasters. Our multidisciplinary team of first responders, project managers, engineers, geologists, and scientists are selected for their technical proficiency and in-depth industry knowledge to aid clients in resolving technical problems. For more, see efiglobal.com.

Key sources and standards

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- PCI MNL-136, Maintenance Manual for Precast Concrete Parking Structures.
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- NHTSA manufacturer-submitted emergency response guides and rescue sheets for electric-powered vehicles.