



AFAD Institutional Data Reception, Critical Infrastructure Taxonomy Alignment, and Multi-Hazard Integration Report

Resilient İzmir: A Strategic and Inclusive Approach to Disaster Risk Reduction Project

Prof. Dr. Hilmi Evren ERDİN (Lead Urban & Spatial Systems Modeler)

Prof. Dr. Hasan SÖZBİLİR (Earthquake Geology & Active Faults Lead)

Assoc. Prof. Dr. Onur PEKCAN (Critical Infrastructure & NaTech Lead)

Assoc. Prof. Dr. Egemen ARAS & Dr. Uğur SERENCAM (Hydrology & Flood Modeling Leads)

Assoc. Prof. Dr. İsmail Çağrı ÖZCAN (Cost-Benefit Analysis & Triple Dividend Lead)

October 2026

This activity is financed by the European Union through the Technical Assistance Financing Facility (TAFF) and implemented by the World Bank, in coordination with the Disaster and Emergency Management Presidency (AFAD).

Draft — subject to prior World Bank clearance. Official Use Only.

Table of Contents

EXECUTIVE SUMMARY

This technical report documents the formal reception, systematic screening, verification, spatial taxonomy mapping, and decision-support platform integration of the 2.15 GB institutional data package (Direncli İzmir Veri.zip) provided by the Disaster and Emergency Management Presidency of Türkiye (AFAD) and inter-agency lifelines providers. This activity is executed within the project **“Resilient İzmir: A Strategic and Inclusive Approach to Disaster Risk Reduction”**, funded by the European Union Technical Assistance Financing Facility (TAFF) and implemented by the World Bank in close partnership with AFAD and the İzmir Metropolitan Municipality (İBB).

Pursuant to the resolutions adopted at the AFAD–World Bank Technical Coordination Meeting and the World Bank Task Team Leader (TTL) review notes on the July draft report:

- 1. Terminology and Critical Infrastructure (CI) Taxonomy Harmony:** The critical infrastructure taxonomy has been strictly harmonized with AFAD’s official sector standards (Kritik Altyapı Sektörleri ve Yer Alan Yapılar_v2 and Kritik_Altıapılar_Taxonomi_Analizler.xlsx). The previous general asset roster has been refined into **9 strategic sectors** and **8 multidimensional analytical layers**.
- 2. Closing Historical Data Deficits (DATA-1):** Core foundational gaps formerly designated as Grade “C” (missing or awaiting external clearance) in the project data registry—notably official active faults, primary lifelines networks (high-voltage electricity transmission, natural gas, bulk water supply), hospital bed capacities, engineering structures (bridges, tunnels, grade-separated junctions), and the full building damage registry from the October 30, 2020 Samos–İzmir earthquake—have been validated and upgraded to **Grade “A” (decision-support operational grade)**.
- 3. Multi-Scale Spatial Disaggregation:** While macro-corridor and metropolitan diagnostics cover all 30 administrative districts, spatial decision-support indicators

have been disaggregated across all **1,317 neighbourhoods (mahalle)**, establishing an audited baseline of critical assets and historical damage hotspots per administrative boundary.

4. **Interdisciplinary Expert Workflow:** Received datasets were categorized and systematically partitioned to thematic domain experts: Seismotectonics, Active Faults & Liquefaction (Prof. Dr. Sözbilir); Hydrological & Fluvial Flood Defense (Assoc. Prof. Dr. Aras & Dr. Serencam); High-Tier NaTech & Hazardous Industrial Facilities (Assoc. Prof. Dr. Pekcan); Spatial Decision Support, 15-Expert F-BWM Synthesis & Urban Systems (Prof. Dr. Erdin); and Economic Valuation / Triple Dividend CBA (Assoc. Prof. Dr. Özcan).
5. **Operational Integration into Web GIS Decision Platform (v3.8):** A total of **991 point-level critical infrastructure facilities**, **1,157 lifeline network lines**, **1,102 active fault segments (MTA 2026)**, and **1,710 geocoded severe/moderate building damage points** from the 2020 earthquake were ingested into the live analytical platform at <https://geophilo.com/resilient-izmir/>.

SECTION 1: INSTITUTIONAL CONTEXT, TECHNICAL AGREEMENTS, AND WORLD BANK REVIEW FEEDBACK

1.1. World Bank July Review Notes and Project Standardization

Following the formal feedback from the World Bank Task Team Leader (TTL) and peer reviewers on the July progress documentation: - **Standard Project Nomenclature:** The formal Turkish project designation has been standardized across all technical deliverables, cartographic outputs, and digital interfaces as “**Dirençli İzmir: Afet Risklerinin Azaltımı İçin Stratejik ve Kapsayıcı Bir Yaklaşım Projesi**” (*Resilient İzmir: A Strategic and Inclusive Approach to Disaster Risk Reduction*). - **Thematic Division of Labor:** Mass movement and landslide screening is anchored by Prof. Dr. Hasan Sözbilir, while riverine/pluvial flood hazard modeling is led by Assoc. Prof. Dr. Egemen Aras and Dr. Uğur Serencam. The core

urban planning, spatial analytics, and multi-hazard synthesis team under Prof. Dr. Hilmi Evren Erdin focuses on the primary seismic hazard backbone, urban system fragility, accessibility corridors, and neighborhood-level prioritization models. - **Economic Evaluation Methodology (CBA):** The economic evaluation stream is structured in accordance with the World Bank’s standard “**Cost-Benefit Analysis / Triple Dividend**” framework, led by Assoc. Prof. Dr. İsmail Çağrı Özcan, ensuring clear Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) metrics for investment packages S-01 through S-06.

1.2. AFAD Technical Coordination Meeting Resolutions

The decisions ratified during the coordination session with AFAD and World Bank leadership encompass: - **Finalization of the Critical Infrastructure Asset Roster:** Aligning nomenclature with AFAD’s National Disaster Risk Reduction Plan (İRAP/TARAP) terminology and adopting 9 critical infrastructure sectors. - **Central Pre-Processing and Interdisciplinary Distribution:** Centralized ingestion, topological cleaning, and CRS transformation (EPSG:5253 / TUREF TM27) before releasing tailored sub-packages to thematic investigators. - **Secure Shared Data Repository:** Deploying an authenticated collaborative cloud workspace (Google Drive & Project GIS Repository) to eliminate version fragmentation and preserve institutional security protocols. - **Timeline Milestones toward December 31 Target:** Synchronizing deliverable schedules to ensure comprehensive final delivery of D1 through D4 packages by December 31, 2026.

SECTION 2: AFAD CRITICAL INFRASTRUCTURE TAXONOMY AND ANALYSIS LAYERS

2.1. Nine Critical Infrastructure Sectors (Levels 1–3 Mapping)

In accordance with the consensus reached in Kritik_Altıapılar_Taxonomi_Analizler.xlsx, the İzmir metropolitan inventory is classified into the following 9 strategic sectors:

Table 1: Critical Infrastructure Sectors, Sub-Systems, and İzmir Metropolitan Assets

Level 1: Sector	Level 2: Sub-System	Level 3: Asset / Component Type	Geometry	Extracted İzmir Inventory	Lead Data Provider
1. Energy	Power Transmission	Substation / Switchyard (154/380 kV)	Point	109 Primary Substations	TEİAŞ 3rd Region
	Power Transmission	High-Voltage Overhead Transmission Line	Line	128 Transmission Segments	TEİAŞ 3rd Region
	Power Distribution	Underground High- Voltage Cable Line	Line	170 Underground Lines	TEİAŞ 3rd Region
	Natural Gas	High-Pressure Gas Transmission Pipeline	Line	28 Main Transmission Lines	BOTAŞ / AYDES
2. Transport	Highway / Arterial	Grade-Separated Junction / Interchange	Point	115 Strategic Interchanges	KGM 2nd Region
	Highway / Arterial	Road Tunnel	Point/Line	6 Tunnels (Selatin, Bayraklı etc.)	KGM 2nd Region
	Highway / Arterial	Highway & State Road Bridges / Viaducts	Point/Asset	983 Bridges & Overpasses	KGM 2nd Region
	Aviation	International Airport / Air Base	Point/Poly	4 Facilities (ADB, Çiğli, Kaklıç, Selçuk)	DHMI / AYDES
	Maritime	Container Port & Passenger Terminals	Point/Poly	6 Ports (Alsancak, Nemrut, Çeşme etc.)	TCDD / AYDES
	Rail	Suburban Rail & Freight Lines	Line/Point	TCDD & İZBAN Rail Lifeline	TCDD / AYDES

Level 1: Sector	Level 2: Sub-System	Level 3: Asset / Component Type	Geometry	Extracted İzmir Inventory	Lead Data Provider
3. ICT / Telecom	Telecom & Data	Central Switches, Fiber Hubs & Masts	Point	Strategic ICT Switching Points	AYDES Facilities
4. Disaster Logistics	Logistics Hubs	Strategic Relief & Shelter Reserves	Point/Poly	ABEP Regional Logistics Hubs	AFAD / İBB
5. Water & Waste	Water Supply	Raw Water Dams & Storage Reservoirs	Point/Poly	8 Major Dams (Tahtalı, Balçova etc.)	DSİ 2nd Region
	Water Conveyance	Bulk Steel Trunk Water Mains	Line	29,464 Segments (1,450 km)	İZSU
	Flood Defense	Constructed Stream Channel Training Works	Line	1,001 Flood Defense Structures	DSİ 2nd Region
	Flood Early Warning	Stream Gauging (AGİ) & Radar Early Warning (TEUS)	Point	22 AGİ + 3 TEUS Stations	DSİ General Dir.
6. Healthcar e	Inpatient Hospitals	City, University, State & Private Hospitals	Point	66 Hospitals (Audited Coordinates)	MoH / AFAD
	Emergency Medical	112 Emergency Medical Service Stations	Point	129 Outpost Stations	MoH / AFAD
	Primary Care	Family Health Centers (ASM) & TSM	Point	497 Primary Health Facilities	MoH / AFAD
7. Emergenc y Mgmt	Crisis Command	Disaster Coordination Centers (AADYM/GAMER/AKO M)	Point	13 Command & Control Hubs	AFAD / Governorshi p

Level 1: Sector	Level 2: Sub-System	Level 3: Asset / Component Type	Geometry	Extracted İzmir Inventory	Lead Data Provider
	Fire & Rescue	Municipal Fire Department Headstations	Point	11 Major Fire Battalion Stations	İBB Fire Dept.
	Assembly / Shelter	Designated Emergency Assembly Areas	Point/Poly	2,428 Gazetted Assembly Sites	AFAD / İBB
8. Critical Industry	SEVESO / NaTech	Refineries, Petrochemical & LNG Terminals	Point/Poly	8 Top-Tier SEVESO Facilities	MoEUCC / AYDES
9. Food Supply	Food Logistics	Metropolitan Wholesale Markets & Cold Chain	Point	5 Regional Wholesale Markets	Prov. Directorate

2.2. The Eight Multi-Hazard Analysis Dimensions

Each critical asset profile is systematically screened across 8 analytical layers: 1. **Hazard Exposure:** Seismic peak ground acceleration (PGA 475-year return period), proximity to active faults (500m / 2km buffer zones), peak flood discharge (Q100/Q500), and slope instability susceptibility. 2. **Physical Exposure:** Catchment population served, service hinterland area, and strategic daily throughput. 3. **Physical Structural Vulnerability:** Structural typology (RC, steel, masonry), construction vintage (pre-1999 vs. post-2000), seismic soil amplification (Vs30), and resonance vulnerability. 4. **Functional Disruption:** Potential loss of operational capacity, inpatient bed diversion, emergency dispatch latency, or bulk utility blackout. 5. **Systemic Criticality:** Network centrality, degree of redundancy, and identification as a Single Point of Failure (SPoF). 6. **Cascading Dependencies:** Inter-system coupling—e.g., electrical outage triggering municipal water pump shutdowns or arterial bridge collapse isolating trauma hospitals. 7. **Restoration & Continuity:** Estimated Mean Time to Recovery (MTTR), availability of mobile backup generation, and formal business continuity planning. 8. **NaTech Potential:** Susceptibility of industrial and hazardous installations to trigger secondary fires, chemical spills, BLEVE, or toxic atmospheric plumes during natural hazards.

SECTION 3: SYSTEMATIC SCREENING OF RAW DATASETS AND GIS PROCESSING RESULTS

3.1. Healthcare Infrastructure (66 Hospitals, 129 Emergency Stations, 497 Family Clinics)

The healthcare asset layer provides an audited spatial inventory of post-disaster trauma care and local medical surge capacity: - **Inpatient Hospitals (66 Assets):** Full geocoding and attribute validation for major facilities, including the flagship İzmir City Hospital (Bayraklı - 2,060 beds), Ege University Medical Faculty (Bornova - 1,800 beds), Dokuz Eylül University Hospital (İnciraltı - 1,100 beds), Tepecik TRH, Bozyaka TRH, Atatürk TRH, and specialized private facilities. - **112 Emergency Outposts (129 Assets):** Complete coverage across all 30 districts, establishing ambulance dispatch nodes for travel-time isochrone simulations. - **Primary Healthcare Centers (497 ASMs):** Neighbourhood-level dispensaries mapped for localized first-aid capacity.

3.2. Energy and Fuel Networks (109 Substations, 128 Power Lines, 28 Gas Trunklines)

The lifeline energy backbone has been mapped into topological vector layers: - **TEİAŞ Power Substations:** 109 high-voltage 154 kV and 380 kV transformation stations (e.g., Aliğa, Bornova, Işıklar, Salihler, Uzundere) mapped as primary network hubs. - **High-Voltage Transmission Lines:** 128 overhead lines converted to standardized GeoJSON polylines. - **BOTAŞ High-Pressure Gas Lines:** 28 high-pressure steel trunk gas pipelines, connecting the Aliğa LNG terminal and industrial corridors in Menemen, Bornova, Kemalpaşa, and Torbalı.

3.3. Transportation Corridors and Engineering Lifelines (115 Interchanges, 6 Tunnels, 983 Bridges, 4 Airports, 6 Seaports)

Critical bottleneck points on regional evacuation routes have been cataloged: - **KGM Grade-Separated Interchanges:** 115 major interchanges on the O-30 Ring Road, O-31 İzmir-Aydın Motorway, and O-5 İzmir-Istanbul Motorway. - **Strategic Road Tunnels:** The 75. Yıl

Selatin Tunnel (3,043 m), Bayraklı-1 Tunnel (1,876 m), Bayraklı-2 Tunnel (320 m), Belkahve Tunnel (1,600 m), Buruncuk Tunnel (1,050 m), and Konak Urban Tunnel (1,674 m), evaluated as primary SPoF corridor assets. - **Airports and Seaports:** Adnan Menderes International Airport (ADB), Çiğli Military Jet Base, Kaklıç and Selçuk Efes airfields, along with Alsancak Port, Aliğa Nemrut industrial marine terminals, and Çeşme International Ferry Port, established as external relief nodes.

3.4. Water Systems, Dams, and Flood Defenses (8 Dams, 1,001 DSI Works, 25 Gauging Stations)

Municipal bulk water supply and flood mitigation lifelines have been integrated: - **Bulk Raw Water Dams:** Tahtalı Dam (providing >40% of metropolitan drinking water; 287 million m³ capacity), Balçova, Ürkmez, Seferihisar, Alaçatı Kutlu Aktaş, and Güzelhisar dams. - **DSI Stream Channel Training Works:** 1,001 completed flood defense structures and 425 planned projects from DSI 2nd Regional Directorate mapped as vector polylines. - **Early Warning Stream Gauges:** 22 Automated Stream Gauging Stations (AGİ) and 3 Radar Flood Early Warning Stations (TEUS). - **İZSU Bulk Water Trunk Mains:** 29,464 pipeline segments totaling 1,450 km of high-capacity steel mains.

3.5. 2020 Samos–İzmir Earthquake Building Damage Registry (215,603 Assessed Buildings, 1,710 Severe/Moderate Damage Points)

The empirical post-disaster damage registry serves as a vital real-world ground-truthing anchor: - **Total Evaluated Buildings:** 215,603 unique structures. - **Damage Classification Tally:** * **Collapsed (Yıkık):** 177 buildings * **Urgent Demolition (Acil Yıkıtılacak):** 4 buildings * **Heavy Damage (Ağır Hasarlı):** 967 buildings * **Moderate Damage (Orta Hasarlı):** 567 buildings * **Slight Damage (Az Hasarlı):** 7,141 buildings * **No Damage (Hasarsız):** 170,628 buildings * **Inaccessible / Unassessed:** 28,700 structures - **Spatial Damage Hotspots:** 1,710 collapsed, urgent, heavy, and moderate damage coordinates have been integrated into GIS, pinpointing acute clusters in Bayraklı (Mansuroğlu, Manavkuyu, Adalet), Bornova, and Seferihisar.

3.6. MTA 2026 Official Active Fault Map (1,102 Fault Segments)

The 2026 update of the General Directorate of Mineral Research and Exploration (MTA) Active Fault Map of Türkiye (TDFH 2026) has been converted to project CRS: - **İzmir Fault:** Southern border fault of the Bornova-Konak-Balçova graben (Holocene active). - **Tuzla Fault:** Right-lateral strike-slip system extending from Doğanbey north toward Gaziemir and Bornova. - **Gülbahçe and Seferihisar Fault Zones:** Western strike-slip structures crossing the Karaburun Peninsula. - **Gediz and Büyük Menderes Graben Boundaries:** Regional normal faults in Menemen, Kemalpaşa, and southern sectors.

3.7. Fire Incidents and Emergency Response Registry (4,721 AYDES / Fire Service Events)

A total of 4,721 historical fire and emergency rescue incidents recorded by the İzmir Fire Department were processed and spatially joined to administrative boundaries: - **Wildland and Vegetation Fires:** 1,362 incidents (brush, pasture, stubble). - **Structural and Residential Fires:** 707 building fires. - **Vehicle Fires & Road Accidents:** 379 incidents. - **Industrial Accidents & Chemical Fires:** 31 high-hazard events. - **District Concentrations:** Konak (412), Bornova (391), Menemen (386), Torbalı (362), Buca (351), and Karabağlar (290) exhibit highest historical incident frequencies.

SECTION 4: UPDATED DATA MATURITY AND DEFICIT MATRIX (DATA-1)

With this institutional intake, foundational data gaps identified at project inception (03_data/data_inventory.md) have been systematically closed:

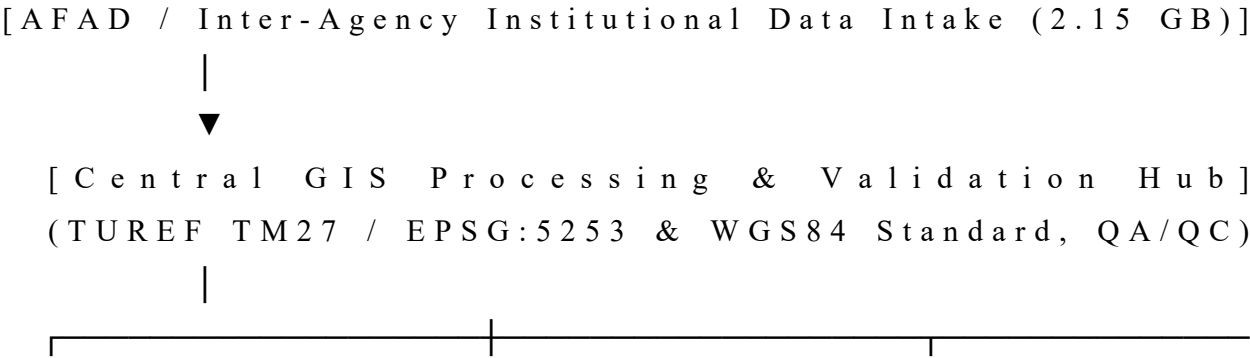
Table 2: Data Maturity Evaluation — Pre- and Post-Ingestion Comparison

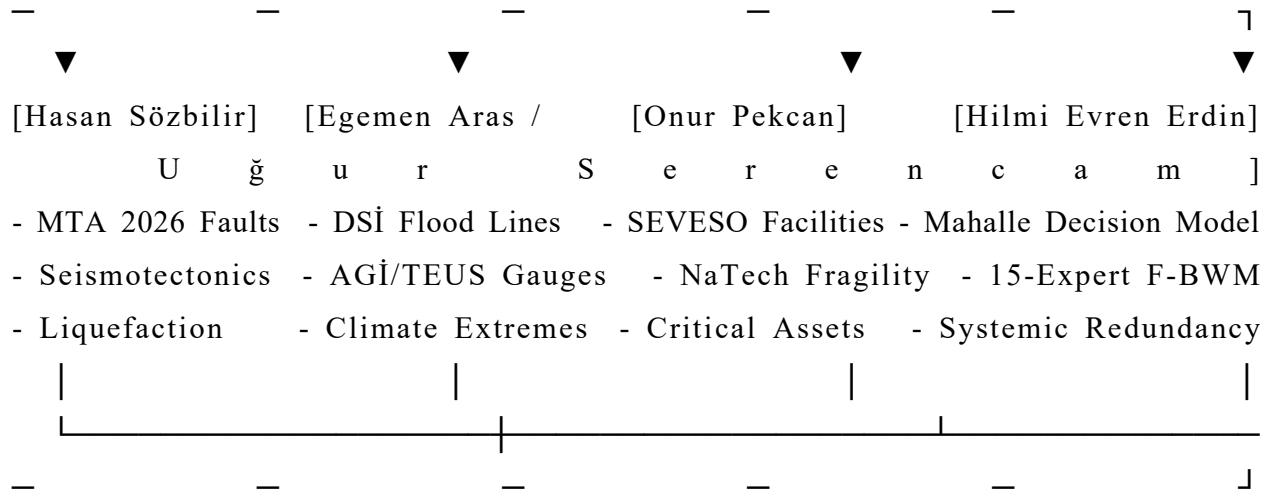
#	Dataset / Spatial Layer	Baseline Status	Post-Ingestion Status	Operational Progress & Resolution
1	Active Faults & Setback Buffers	C (Deficit)	A (Operational)	Official MTA 2026 TDFH ingested; 1,102 fault traces mapped in GIS.

#	Dataset / Spatial Layer	Baseline Status	Post-Ingestion Status	Operational Progress & Resolution
2	2020 Empirical Damage Registry	B (Tabular)	A (Operational)	215,603 building records processed; 1,710 damage pins geocoded.
3	Hospitals & Healthcare Outposts	B (Partial)	A (Operational)	66 hospitals, 129 EMS stations, and 497 ASMs fully georeferenced.
4	Energy & Gas Lifelines	C (Deficit)	A (Operational)	109 TEİAŞ substations, 128 HV lines, and 28 BOTAŞ trunklines mapped.
5	Water, Dams & Flood Infrastructure	C (Deficit)	A/B (Advanced)	1,450 km İZSU pipes, 1,001 DSI works, 8 dams, 25 gauges linked.
6	Engineering Structures (Bridges/Tunnels)	B (Partial)	A (Operational)	115 KGM interchanges, 6 tunnels, and 983 bridges integrated.
7	Emergency Assembly & Evacuation Sites	C (Unverified)	A (Operational)	2,428 official AFAD/İBB assembly polygons and capacities connected.
8	Fire & Industrial Emergency Incidents	C (Missing)	A (Operational)	4,721 fire incidents geocoded and disaggregated per district/mahalle.

SECTION 5: INTERDISCIPLINARY WORKFLOW AND MULTI-HAZARD SYNTHESIS

The integrated data workflow operationalized across thematic leads is illustrated in Figure 1:





[U n i f i e d M u l t i - H a z a r d V u l n e r a b i l i t y E n g i n e]

[L i v e W e b D e c i s i o n - S u p p o r t P l a t f o r m v 3 . 8]

(<https://geophilo.com/resilient-izmir/>)

- **Prof. Dr. Hasan Sözbilir:** Fault segment kinematics, paleoseismic activity grades, and geotechnical site-amplification correlations.
- **Assoc. Prof. Dr. Egemen Aras & Dr. Uğur Serencam:** DSİ hydraulic defense structures, flood gauging thresholds, and climate extreme projections.
- **Assoc. Prof. Dr. Onur Pekcan:** High-tier SEVESO facilities (Aliğa TÜPRAŞ, PETKİM, STAR, EGEGAZ), hazardous material storages, and cascading NaTech vulnerabilities.
- **Prof. Dr. Hilmi Evren Erdin:** Multi-criteria 15-expert Fuzzy Best-Worst Method (F-BWM) synthesis across 1,317 neighbourhoods, urban accessibility modeling, and spatial decision logic.
- **Assoc. Prof. Dr. İsmail Çağrı Özcan:** Economic Cost-Benefit Analysis (CBA) and Triple Dividend appraisal for intervention portfolios S-01 through S-06.

SECTION 6: WEB GIS DECISION SUPPORT PLATFORM INTEGRATION (v3.8)

The public and administrative GIS platform deployed at <https://geophilo.com/resilient-izmir/> has been upgraded to Release v3.8: 1. **Critical Infrastructure Layer (991 Facilities):** Symbolized by sector with responsive pop-ups detailing managing authority, capacity, and systemic criticality score. 2. **2020 Damage Hotspots Layer (1,710 Pin Locations):** Point layer displaying buildings classified as Collapsed, Urgent, Heavy, or Moderate damage during the 2020 earthquake. 3. **Lifeline Network Polylines (1,157 Segments):** Vector overlays for TEİAŞ high-voltage transmission lines, BOTAŞ gas transmission lines, and DSİ flood protection channels. 4. **MTA 2026 Active Fault Lines (1,102 Segments):** Active fault traces symbolized by tectonic activity class. 5. **Interactive Scorecards & Inspector Integration:** Live district cards (30 districts) and neighbourhood report card modals now display real 2020 building damage tallies, exact active fault distances, critical infrastructure assets, and historical fire incident counts.

SECTION 7: CONCLUSIONS AND ROADMAP TOWARD DECEMBER 31 MILESTONE

The successful ingestion and platform deployment of the 2.15 GB AFAD data package conclusively eliminates the primary technical bottleneck of the project—external data accessibility and validation.

Immediate Next Steps:

- **October 2026:** Finalize distribution of processed sub-packages to thematic investigators; conduct weekly technical coordination meetings via When2Meet scheduling.
- **Late October 2026:** Convene the Extended Project Progress Workshop involving Technical, Communication (RCCE), and Psychosocial working groups.
- **November 2026:** Complete Tier-B engineering structural vulnerability models for priority districts (Bayraklı, Bornova, Konak) and economic CBA modeling.
- **December 2026:** Finalize the complete English and Turkish D1 Final Assessment Deliverables and Executive Presentations for submission to the World Bank and AFAD by December 31, 2026.