



US Army Corps  
Of Engineers®

## ***USACE Support to FEMA-WV Public Assistance Task Force (2016)***



**FEMA-4273-DR, WEST VIRGINIA FLOODING 2016**

**USACE EXECUTION OF FEMA 50% ANALYSIS (October 2016)**

**Kanawha County Schools (Clendenin Elementary & Herbert Hoover High)**

**Nicholas County Schools (Richwood Middle & High, Summersville Middle)**

**PREPARED BY: USACE EMERGENCY OPERATIONS**

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## Executive Summary

**Background:** The Corps of Engineers was tasked with determining both the repair and replacement costs for the following five schools damaged during the West Virginia flood event in June 2016:

1. Clendenin Elementary School---Kanawha County
2. Herbert Hoover High School----Kanawha County
3. Summersville Middle School--- Nicholas County
4. Richwood Middle School----- Nicholas County
5. Richwood High School----- Nicholas County

**FEMA 50% Rule:** The rough order of magnitude (“ROM”) estimates for the repair and replacement alternatives reflect the estimated cost to perform required repairs to the existing building in accordance with FEMA FP 104-009-2 (dated January 2016) and 44 CFR §206.222(f).

- 1) 50% RULE CALCULATION:

$$RATIO = \frac{REPAIR\ COST}{REPLACEMENT\ COST} \times 100\%$$

Where:

- *RATIO > 50% supports the REPLACEMENT alternative*
- *RATIO < 50% supports the REPAIR alternative*

- 2) REPAIR COST ALTERNATIVE: FEMA’s FP 104-009-2 (clarification to 44 CFR §206.222(f) clarifies repair cost as (see page 96):

“...THE COST OF REPAIRING DISASTER-RELATED DAMAGE ONLY AND INCLUDES COSTS RELATED TO COMPLIANCE WITH STANDARDS THAT APPLY TO THE REPAIR OF THE DAMAGED ELEMENTS ONLY. (THIS COST) DOES NOT INCLUDE COSTS ASSOCIATED WITH: UPGRADES OF NON-DAMAGED ELEMENTS EVEN IF REQUIRED BY STANDARDS (E.G. ELEVATION OF AN ENTIRE FACILITY TRIGGERED BY REPAIR); DEMOLITION BEYOND THAT WHICH IS ESSENTIAL TO REPAIR THE DAMAGED ELEMENTS; SITE WORK; SOFT COSTS; CONTENTS; HAZARD MITIGATION MEASURES; EMERGENCY WORK.”

- 3) REPLACEMENT COST ALTERNATIVE: FP 104-009-2 clarifies repair cost as (see page 97):

“...THE COST OF REPLACING THE FACILITY ON THE BASIS OF ITS PRE-DISASTER DESIGN (SIZE AND CAPACITY) AND FUNCTION IN ACCORDANCE WITH APPLICABLE STANDARDS. (THE COST) DOES NOT INCLUDE: DEMOLITION; SITE WORK; SOFT COSTS; CONTENTS; HAZARD MITIGATION MEASURES; EMERGENCY WORK.”

- 4) FEMA 50% RULE CALCULATIONS vs. ELIGIBILITY FOR PA FUNDING: FEMA's FP 104-009-2 (clarification to 44 CFR §206.222(f) clarifies repair cost as (see page 96):

"...ALTHOUGH CERTAIN COSTS ARE NOT INCLUDED IN THE 50% RULE CALCULATION TO DETERMINE WHETHER THE FACILITY IS ELIGIBLE FOR REPLACEMENT, THE COSTS MAY BE ELIGIBLE FOR PA FUNDING SUBJECT TO ALL OTHER ELIGIBILITY REQUIREMENTS."

## School Assessments

### FINDINGS – General to All Schools

- Replacement of inundated flooring finish (including gym flooring where applicable)
- Replacement of ceiling tiles throughout due to humidity and growth of mold
- Cleaning, treating, and repainting of existing surfaces on flood damaged floors only
- Replacement of interior and exterior doors on flood damaged floors. Includes door, frame, and associated hardware.
- Remove/replace inundated plumbing fixtures including sinks, fountains, toilets, privacy partitions/doors
- Major electric power systems need replaced and repaired, including distribution panels, outlets and wiring.
- Mechanical/boiler rooms require total replacement, including boilers
- Minor to moderate damage to classroom heating equipment required.
- INCLUDED – Fixed kitchen equipment, classroom casework, laboratory casework, fixed athletic equipment lockers \*In both repair and replacement estimates
- EXCLUDED – Contents and furnishings are excluded from the FEMA 50% analysis.
- EXCLUDED – "Soft" costs including general contractor's overheads, profit, bond and owner costs including contingency and escalation.

FP 104-009-2 (Jan. 2016):

"Soft Costs" are those not considered as direct construction costs, including:

- Architectural design
- Engineering costs
- Project management
- Financing
- Legal fees
- Other pre-/post construction expenses



## Clendenin Elementary School---Kanawha County

**Location:** Clendenin, WV

**Description:** Two story brick veneer structure built in 1931

**Damage:** Flood waters reached between three to four feet. First floor walls, floors, entire basement/boiler room, elevator a/c units, wiring.

### FINDINGS – Clendenin Elementary School

- All general recommendations (prior stated).
- The entire heating /ventilating system along with all utilities electrical, water, wiring switches, motors fans and alarms in the basement are a total loss.
- The window air conditioner cannot be economically repaired.
- The first floor entire electrical, fire alarm, communication, audiovisual and computer systems wiring and equipment cannot be economically repaired (photo 13).
- The first floor in the original building consist of 12x12x12 or 12 x12 x10 inch clay tile imbedded under 2.5 inch concrete slab and between 2 inch concrete joists poured integral with the slab (photo 14 and 15). Sleepers, wood sub and finished floors were placed above the concrete deck. Accordingly, the wood products particularly the hardwood sub and finished floors are largely destroyed.
- The first floor interior walls, particularly those of wallboard are in need of replacement. In addition, walls over runs of damaged hard wood flooring must be removed and replaced.
- The elevator pit and associated hydraulic equipment are presumed flooded as it was not possible to access the elevator shaft and pit.
- The elevator cab is presumed to have sustained 3 to 4 feet of water damage.
- The elevator controls were subjected to flood water and are not reliable.
- Basement, first floor and second floor wiring, including ,electrical, communications, controls, alarms and annunciators for the fire alarm system are compromised and requires evaluation and replacement as necessary.
- Replace two walk-in freezers.
- Replace loading dock.
- Replace second floor ceiling tile.
- Replace first floor wood floor joists with concrete slab on grade.
- Replace all 16 window units and 8 Bard air conditioner units with a central HVAC system.
- Replace concrete basement access wall and stairs along with the wood access door.
- Remove all existing HVAC systems. Replace with new code compliant systems.
- Remove all existing utilities that are below grade. Provide new utility connections in location above grade in flood resistant location.
- Rebuild kitchen including providing new walk in cooler and freezer. Upgrade or replace kitchen hood and replace exhaust fan to support new kitchen equipment
- Replace basement domestic hot water heating system. Locate new system above flood elevation.
- Replace all first floor plumbing fixtures.

- Repair existing fire alarm
- Repair existing building automation system

## Herbert Hoover High School----Kanawha County

Location: Elkview, WV

Description: Two story brick veneer structure built in 1962

Damage: Flood waters reached between six to eight feet. First floor walls, floors, entire basement/boiler room, elevator a/c units, wiring, generator, water heaters.

### FINDINGS – Herbert Hoover High School

- All general recommendations (prior stated).
- Clean / sanitize and repaint, as applicable, all interior first floor surfaces not being replaced. Clean / sanitize all second floor surfaces not being replaced.
- Remove, clean, prepare, and replace all interior floor finish and base finish materials. Includes first and second floors. Includes stair tread and riser cover material.
- Remove, clean, prepare, and replace all ceiling finishes materials. Includes second floor where acoustical ceiling tiles exist. Include cement fiber decking of exterior door canopies.
- Remove, clean, prepare, and replace all wall finish materials that can support mold growth. This is typically materials such as wood, drywall, restroom stall partitions, and insulation.
- Replace all first floor doors, hinges, hardware, and frames. Typically metal panel exterior doors and solid wood interior doors exist. This includes door frame demolition and replacement.
- Replace all first floor windows and frames. This includes window frame demolition and replacement.
- Remove and replace all inundated fixtures and equipment, such as sinks, toilets, kitchen equipment, shop equipment, auditorium seating, and benches.
- Remove and replace all specialty type finishes such as auditorium curtains, stage material, sound attenuating panels, mirrors, etc.
- Recommend performing all work required to visually assess the structural condition of base plates and anchor bolts for approximately 10% of the existing steel columns of the original 1962 construction (approximately 12 columns). Includes excavation of adjacent slab-on-grade, adjacent portions of wall, and adjacent earth, as necessary to reveal the column base. Assume restoration work for each of these columns in the form of cleaning, preparation, and application of new paint system.
- Demo and replace approximately 78 sq. ft. of CMU wall at west end of vault.
- Demo and replace portable classroom facility located at the south-west corner of the building.
- Remove majority of existing HVAC systems. Replace with new code compliant systems.
- Replace all plumbing fixtures on the first floor.
- Replace electrical switchgear damaged by flood
- Provide new electrical service outside of the flood zone
- Replace first floor lighting, wiring, raceways, receptacles, and lighting and power distribution panels
- Replace second floor wiring, raceways, and receptacles that were damaged by the flood

## **Richwood Middle School--- Nicholas County**

**Location:** Richwood, WV

**Description:** One story CMU building with slab on grade built in 1957.

**Damage:** Flood waters reached between two to four feet. First floor walls, floors, entire boiler room, wiring, water heaters.

### **FINDINGS – Richwood Middle School**

All remaining surfaces are to be dried completely before any rebuild work is considered. The building doors and windows have been closed for an extended period of time. It is highly recommended that indoor air quality clearance testing be conducted prior to the building being re-occupied. Repair work can be summarized as follows:

- All general recommendations (prior stated).
- Clean / sanitize and repaint all painted interior surfaces.
- Remove, clean, prepare, and replace all interior floor finish and base finish materials.
- Remove, clean, prepare, and replace all ceiling finishes materials.
- Remove, clean, prepare, and replace all wall finish materials that can support mold growth. This is typically materials such as wood, drywall, and insulation.
- Replace all doors, hinges, hardware, and frames. Typically metal panel exterior doors and solid wood interior doors exist. This includes door frame demolition and replacement. In addition, some selective CMU wall demolition adjacent to approximately 18 interior doors is recommended for meeting ADA requirements. See assessment details.
- Completely demolish and replace the 1991 addition portion of the building. This is approximately 24,000 square feet of the facility. It consists of CMU load bearing and non-load bearing walls. Open web steel joists supporting the concrete roof deck provide the roof diaphragm. Without a much more thorough investigation that includes geotechnical concerns and settlement studies over a period of time, in which new findings are discovered, this is the only recommendation the current assessor is prepared to recommend.
- Demo and replace approximately 784 square feet of 8" CMU wall elevation for the North-Western most classroom. Prominent cracks and slab and wall separation are apparent here.
- Demo and replace approximately 960 square feet of 8" CMU wall elevation for the classroom located around the midsection of the building.
- Further investigate the approximate 2,000 square feet of cafeteria floor that is overly sloped. Repair as recommended from investigation. Provide additional supports or realign as necessary.
- Despite its appearance and working condition, the entire building suffered complete flooding. Electrical equipment within the flood mark should be selectively replaced. Several key systems were installed above this level; the main electric components may be reusable if certified by an electrician.
- The main heating boiler is operational, but should not be reused due to the open burner design and age. Heating in classrooms can be reused with minor repairs. Window AC units were within the flood zone and need to be replaced.
- Replace HVAC systems for all areas except for existing roof top units (RTU)

- Replace heating boiler as needed for new HVAC system
- Replace plumbing fixtures on first floor subjected to flood waters

**Richwood High School----- Nicholas County**

**Location:** Richwood, WV

**Description:** Two story brick veneer building with crawl space built in 1961

**Damage:** Flood waters reached between two to four feet. Mechanical room floor walls, entire boiler room, wiring, water heaters.

**FINDINGS – Richwood High School**

All remaining surfaces are to be dried completely before any rebuild work is considered. The building doors and windows have been closed for an extended period of time. It is highly recommended that indoor air quality clearance testing be conducted prior to the building being re-occupied. All repair work listed below is only applicable to the first floor of the 1979 and 1990 building addition, which has been previously described as having a finished floor elevation that is roughly 4 feet below the finished floor of the original construction (classroom wing with crawl space). Only when identified, a particular repair work item may also apply to other portions of the building. Reference the building plan as needed.

Repair work can be summarized as follows:

- All general recommendations (prior stated).
- Clean / sanitize and repaint all painted interior surfaces of the first floor.
- Remove, clean, prepare, and replace all interior floor finish and base finish materials. Due to potential moisture degradation, this repair recommendation also applies to the first floor of the classroom wing.
- Remove, clean, prepare, and replace all ceiling finishes materials. This also applies to acoustical ceiling tiles of the classroom wing, and applies to first and second floor levels.
- Remove, clean, prepare, and replace all wall finish materials that can support mold growth. This is typically materials such as wood, drywall, and insulation.
- Replace all doors, hinges, hardware, and frames. Typically metal panel exterior doors, overhead coiling exterior doors, and solid wood interior doors exist. This includes door frame demolition and replacement. See assessment details.
- Further clean debris from entire crawl space under classroom wing. Install insulation and vapor barrier within entire crawl space of classroom wing.
- Investigate foundation material and stabilize the wall foundation along the perimeter of the building that can be considered a structural concern. Summary provided below. See full assessment for further detail.
  - Develop and initiate a contract with a geotechnical engineering firm to investigate the foundation material adjacent to the approximate 125 ft. of exterior wall footing along the south-east gym corner and adjacent south end of the library.
  - Perform resulting foundation repair recommendation of installing 26 piles at an average depth of 20 ft. each, spaced at 6 ft. on-center, requiring 112 cubic yards of excavation, and requiring 6 employees and 2 mini excavators two weeks to complete.
- The entire mechanical room was flooded, including four modular boilers, domestic hot water, pumps, the building automation and fire alarm panels. Like Herbert Hoover, between the damage, risk of danger from reuse and multiple code deficiencies, complete replacement with a new design is required.

- Even though the main electric power is currently operational, it was completely flooded; due to its extreme age and poor condition, it should be replaced. It cannot be updated with new components.
- Electric wiring and outlets should be replaced where flooded. However, the elevated areas can remain.
- HVAC heating units in classrooms and offices was flooded but it can be safely reused after minor repairs. Other HVAC equipment on the roof was not affected.
- Even though the main electric power is currently operational, it was completely flooded; due to its extreme age and poor condition, it should be replaced. It cannot be updated with new components.
- Electric wiring and outlets should be replaced where flooded. However, the elevated areas can remain.
- HVAC heating units in classrooms and offices was flooded but it can be safely reused after minor repairs. Other HVAC equipment on the roof was not affected.
- Replace HVAC systems for all areas except for existing roof top units (RTU) serving gym
- Replace electrical switchgear damaged by flood
- Provide new electrical service outside of the flood zone to replace the original building service
- Replace wiring, conduits, and receptacle in floor of gymnasium
- Replace fire alarm system

## Summersville Middle School--- Nicholas County

**Location:** Summersville, WV

**Description:** One story brick veneer building built in 1991

**Damage:** Flood waters reached between two to four feet. First floor walls, floors, boiler room, wiring, generator, water heaters.

### FINDINGS - Summersville Middle School

- All general recommendations (prior stated).
- The design of the school included caissons and grade beams to bridge over poor soil conditions.
- The caissons and grade beams support the building perimeter but not some interior slabs.
- The first floor entire electrical, fire alarm, communication, audiovisual and computer systems are compromised.
- Wiring and equipment, not in the ceiling, cannot be economically repaired.
- Ceiling to floor step cracks emanating from roof joists are a product of roof loads combined with differential settlement of the clay soil below the slab on grade are present in a large part of the structure.
- Non load bearing walls have become bearing in some cases due to roof/ceiling deflections due to roof loading and deck (slab) settlement.
- The first floor interior walls, particularly those of wallboard are in need of replacement.
- 10 concrete core samples along with subsoil samples established no deck issues but confirmed poor clay soil over strip mine spoil fill (Photo 21).
- The first floor interior walls, particularly those of wallboard are in need of replacement.
- The CMU block walls do not appear to contain sufficient joint reinforcement or bond beams. There is a bond beam called for on the top course of block. Joint reinforcement is required every 16 inches vertically.
- Load bearing walls do not appear to contain grouting and reinforcement.
- CMU wall corners and other wall transition do not appear to be properly structurally connected.
- First floor wiring, including, electrical, communications, controls, alarms and annunciators for the fire alarm system are compromised and requires evaluation and replacement as necessary.
- CMU course misalignment appears to be a product poor workman ship and differential settlement.
- Excavation to expose the caisson and grade beam revealed that the caissons and grade beams are functioning as intended (photo 22, 23 and 24).
- The deck deflections in rooms 101 and 102 are not the result of grade beam or caisson issues but rather differential settlement. Apparently a portion of the deck adjacent to the grade beam is bearing on the grade beam while the remainder of the slab resting on the fill has settled.
- The settlement in rooms 101 and 102 can be expected to be exacerbated by the flood event over time resulting in further settlement of the deck.
- The recently available geotechnical concludes that reliance on the poor fill material under the structure, which was made worse by the subject flood is not a reliable foundation material.
- Repairs requires reliance on the current grade beams and piers foundation utilizing monolithic construction incorporating structural slabs for all floors throughout the school.



- The entire current wall structure, including the classrooms, gym and all other parts of the school with its water compromised prolific CMU wall cracks are in a weakened, mold/mildew vulnerable condition and will be replaced with CMU containing proper reinforcement.
- The roof loads will supported by structural steel.
- The generator will be replaced.
- Replace flood damaged operators and power on gym louvers
- Replace damaged kitchen equipment
- Replace walk in cooler and freezer
- Replace domestic water heater
- Replace flood damaged electric distribution panels
- Replace flood damaged main switchgear panel
- Replace plumbing fixtures on first floor
- Repair flood damaged portions of existing fire alarm systems

**Basis of Estimates:** The Rough Order Magnitude (ROM) Estimate was prepared on the basis of a site visit and site data collection, including associated as-built drawings for the existing facilities.

1. Labor: The estimate is based on the estimate of current local prevailing wage rates via labor market research through published State of West Virginia prevailing wage rates and the US Bureau of Labor Statistics relevant to the Kanawha and Nicholas County areas. Davis-Bacon Wage Determinations typically required for federally funded projects are not applicable to FEMA PA funding per exemption within the Robert T. Stafford Disaster Relief Act. FEMA's wage and hour division (WHD) states the following:

“GRANTS FOR DISASTER RELIEF UNDER FEMA’S PRINCIPAL RELIEF AUTHORITY, THE ROBERT T. STAFFORD DISASTER RELIEF ACT, ARE NOT SUBJECT TO THE DBA PREVAILING WAGE REQUIREMENTS. FEMA PROVIDES GRANTS FOR DISASTER ASSISTANCE INCLUDING LOW-INTEREST LOANS TO REPAIR OR REPLACE PERSONAL PROPERTY, BUSINESS DISASTER LOANS TO FUND REPAIR OR REPLACEMENT OF REAL ESTATE, AND ASSISTANCE TO STATE OR LOCAL GOVERNMENTS TO PAY COSTS OF REBUILDING A COMMUNITY’S DAMAGED INFRASTRUCTURE.”

2. Equipment: The estimate is based on EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule – Region II, dated November 2014. Fuel and electricity pricing was updated to current local market rates per [www.fuelgaugereport.com](http://www.fuelgaugereport.com) and <http://www.eia.gov> but updated for current local market conditions.
3. Material: Vendor quotes have been acquired and documented only for unique features of work. Material prices were referenced from the 2015 USACE Unit Price Book (UPB).
4. RS MEANS Pricing & Subcontractor Quotes: Sub bid pricing was referenced from the 2015 USACE Unit Price Book (UPB) and/or RS MEANS 2015 Building Construction and Square Foot Costs Pricing Manuals. Subcontractor quotes were only obtained to verify a few unique features of work (e.g. hardwood gym flooring).
5. Sales Tax: Sales tax has been included at 6.0% on material costs.
6. Quantities: Quantities were developed and checked/verified by the USACE team.
7. Crews: In considering the crews and crew outputs, the estimator typically referenced national reference manuals such as R.S. MEANS construction data and the MII Unit Price Book.
8. Work Schedule/Overtime: The estimate assumes a general work schedule of 5 days per week at 8 hours per day, therefore an overtime markup has not been applied.
9. Subcontractor Markups: A general subcontractor markup (considering JOOH & HOOH) has been applied at 15% for all subs. A profit of 10% for subcontractors has also been applied.
10. Prime Contractor’s markups: All prime contractor markups **excluded** per FEMA 50% Rule policy requirement, considering these “soft costs”.
11. Owner Markups: All owner markups are **excluded** per FEMA 50% Rule policy requirement, considering these “soft costs”.

## Analyses Results

**Table 1. USACE Analyses Results of FEMA 50% Rule**

Facility	Repair Estimate	Replace Estimate	Ratio
Clendenin Elementary	\$3,343,466	\$6,275,207	53%
*Herbert Hoover High	\$11,294,191	\$18,023,356	63%
*Richwood Middle	\$5,602,481	\$7,965,086	70%
*Richwood High	\$7,620,811	\$12,363,340	62%
Summersville Middle	\$10,818,477	\$13,152,536	82%
Richwood Campus	\$13,223,292	\$20,328,425	65%

Note: Schools marked with an \* are located in the Floodway.

## References:

The following literature has been used as reference material during the execution of the 50/50 analysis:

- 44 CFR §206.222 (current as of 12 September 2016)
- FEMA FP 104-009-2 Public Assistance Program and Policy Guide (dated January 2016)
- FEMA CEF for Large Projects Instructional Guide V2.1 (dated September 2009)
- EM 1110-2-1304, Civil Works Construction Cost Index Systems (CWCCIS), 30 September 2015.
- EP 1110-1-8, Construction Equipment Ownership & Operating Expense Schedule, November 2014.
- ER 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993.
- ER 1110-2-1302, Civil Works Cost Engineering, 30 June 2016.
- Public Law 93-288, Robert T. Stafford Disaster Relief and Emergency Assistance Act, April 2013

