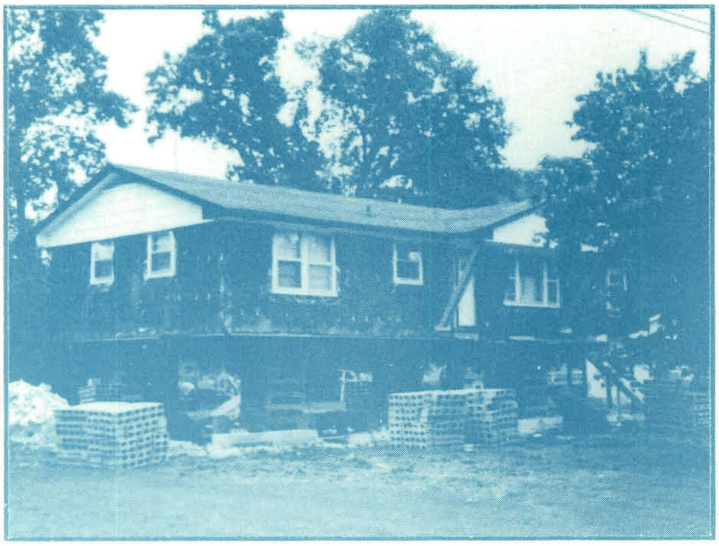
A FLOOD PROOFING SUCCESS STORY



along Dry Creek
at Goodlettsville, Tennessee

US Army Corps of Engineers
Flood Proofing
NATIONAL FLOOD PROOFING COMMITTEE

April 1995

Front Cover Photographs:

Typical Home on Dry Creek

Top *—Before Flood Proofing*

Middle *—During Flood Proofing*

Bottom *—After Flood Proofing*

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Nashville District Corps of Engineers
for
Corps of Engineers
National Flood Proofing Committee

Preface

House raising is one type of flood proofing that can be used to reduce or eliminate flood damage to floodprone homes.

This report documents a successful flood proofing project in Goodlettsville, Tennessee (near Nashville), where 19 homes were raised-in-place. It has been prepared under the direction of the Corps of Engineers National Flood Proofing Committee as part of its ongoing efforts to assist government agencies and property owners in understanding and using flood proofing techniques.

This report provides the project background and gives a detailed description of the homes involved, the implementation procedure used, and the project costs incurred. A *nonstandard* approach was used that reduced administrative costs by reducing Corps of Engineers' involvement and maximized homeowner involvement and satisfaction by allowing the homeowners to control many aspects of the project.

Appendix A presents samples of documents (information packages, agreements, covenants, etc.) used in the program. *Appendix B* summarizes the cost data and offers an equation that can be used to quickly estimate costs during the early planning estimates on similar projects.

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INTRODUCTION

Have you ever considered house raising as part of the solution to a flooding problem only to hear from others, "house raising costs too much, it's never cost effective," or "the local sponsor won't support the plan because the homeowners won't like it?" While those statements may reflect past experience with house raising, a different administrative approach recently helped the Corps of Engineers Nashville District overcome those obstacles and implement a successful cost-effective house raising project, which was a part of the Dry Creek Flood Control Project. In this report the house raising phase of the project is referred to as the Dry Creek Project.

This report documents the simplified administrative procedures used in the Dry Creek Project to reduce costs and points out some advantages and limitations of the method. The report also presents modifications to the procedures which the Nashville District made to accommodate different conditions which may be encountered elsewhere.

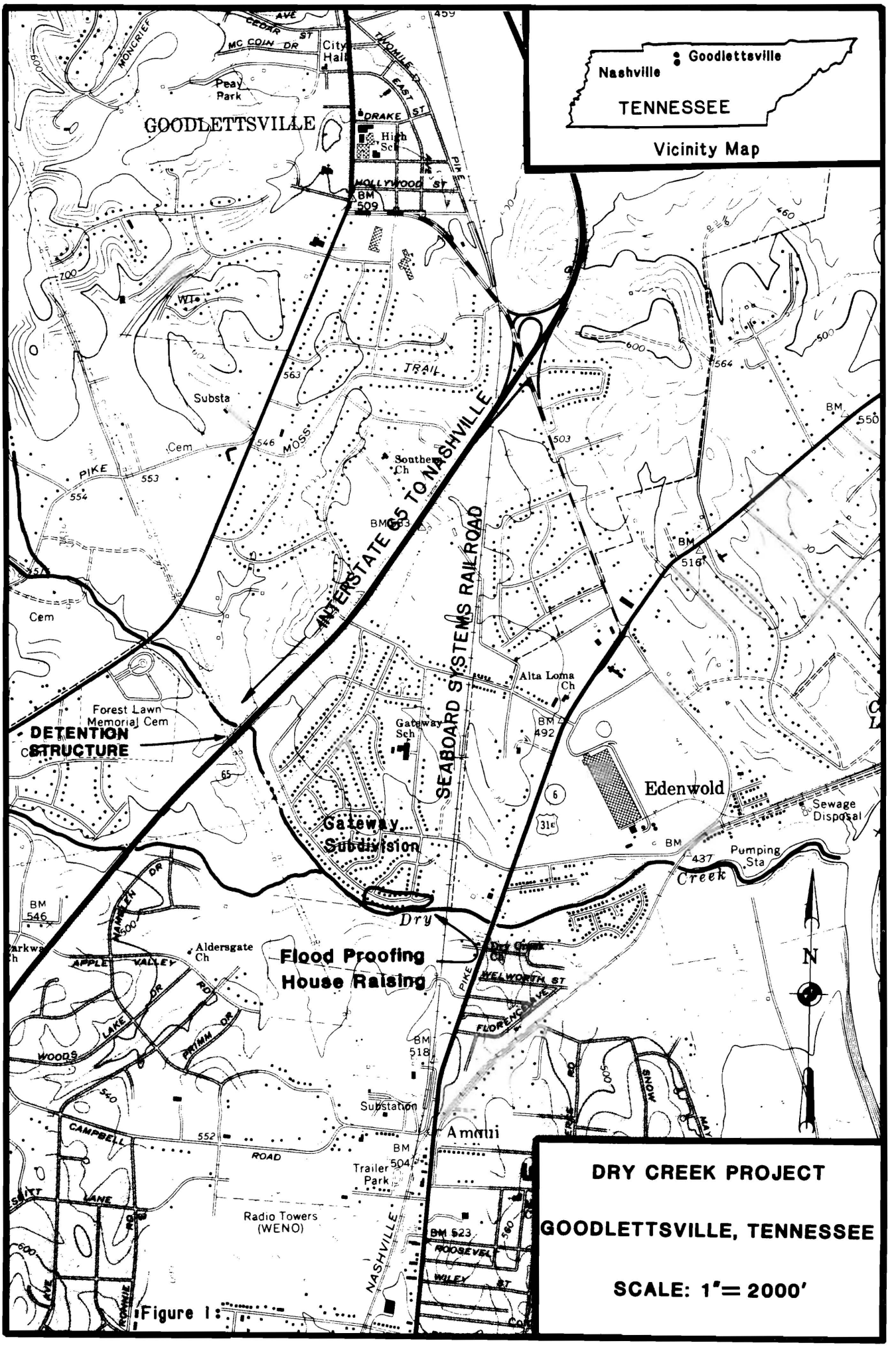
PROJECT BACKGROUND

The Dry Creek Project was studied, designed and constructed under Section 205 of the Corps of Engineers' Continuing Authorities Program. The project is located about 10 miles north of downtown Nashville, Tennessee. Dry Creek is the boundary between the city of Goodlettsville and Metropolitan Nashville. The majority of the project activity took place on the Goodlettsville side of Dry Creek. Metropolitan Nashville was the cost sharing "local sponsor" and its share was 25 percent of the implementation cost. Homeowners incurred no costs unless they constructed additions to their homes at their own expense.

The purpose of the project was to reduce damages as a result of flooding in the Gateway Subdivision between Interstate 65 and the Seaboard Systems Railroad, see Figure 1. There were 46 homes in the 100-year flood plain within that reach. These homes were constructed prior to delineation of the flood plain.

The plan-of-action for the Gateway Subdivision called for the combination of a detention structure and flood proofing to resolve the problem. The detention structure reduced the flooding for all houses in the Gateway Subdivision. However, 19 of the 46 houses' first floor elevations remained below the 100-year flood elevation. The Nashville District flood proofed those 19 houses by raising their first floors above the 100-year flood elevation. The house raising began in March 1989 and was completed in June 1990.

The total cost of the Dry Creek Project was $1.2 million. The benefit-cost ratio (BCR) for the project was 2.4, and the incremental BCR for the flood proofing was 1.2.



DRY CREEK PROJECT

GOODLETTSVILLE, TENNESSEE

SCALE: 1"= 2000'

Figure 1

When flood proofing was considered in the feasibility study phase, a review of the Corps of Engineers' house raising experience revealed two problem areas — high costs and homeowner apprehension. The solution to both problems involved minimizing the Corps of Engineers' role and maximizing the homeowner's role.

Traditionally, the Corps of Engineers has raised houses by the "plans and specs - advertisement - sealed bid process" where the homeowner has little or no input, and the contractor's work is directed and inspected by the Corps of Engineers. The goal in the Dry Creek Project was to reduce Corps of Engineers involvement and increase homeowner participation. This was accomplished by changing the standard procedure and allowing the homeowners to select their own contractors and direct the work. In very simple terms, the Corps of Engineers said to each homeowner "you get your house raised, and we will pay for it." The *non-standard* homeowner agreement was submitted to Division and Headquarters in November 1988 and approved in March 1989. Project implementation started that same month.

PROJECT IMPLEMENTATION

PRE-CONSTRUCTION

Information Phase

Project implementation began by communicating with the homeowner. Each homeowner was given a package explaining the house raising program in general, the Corps of Engineers' role, and the homeowner's responsibilities. The homeowners were also given information to pass along to prospective contractors. The information packages, along with other sample documents used in the program, are shown in *Appendix A*.

Scoping, Proposals, Contracts

The homeowners were required to obtain at least three proposals from contractors of their choice and submit them to the Corps of Engineers. It was emphasized to the owners that their meetings with the contractors were very important since that would be their opportunity to exchange ideas and recommendations, and gain familiarity with the contractors. The Corps of Engineers supplied estimating forms for the contractors in the information packages. Use of the forms was suggested, but not required.

The Continuing Authorities project manager and a cost engineering representative measured and inspected each house so that costs could be developed. Following a review of the particular aspects of each house, the project manager and the cost engineer independently developed estimates for each house. Since plans and specifications were not prepared, the Corps of Engineers essentially developed generic "fair and reasonable" estimates for each specific house. After the two Corps of Engineers estimates were prepared, a single amount was agreed upon (usually an average of the two), and that value became the government estimate.

Before the offer to the homeowner was finalized, the Corps of Engineers reviewed the contractors' proposals to verify (as much as possible) the assumed scope-of-work. On occasion, the government estimate was adjusted after review of the proposals. After the government estimate was finalized, a Memorandum for Record was prepared to document the costing process. The Corps of Engineers' "offer" included construction costs and a $200 legal allowance to the homeowner.

The next step was the homeowner's negotiation of a contract with his selected contractor. Without exception, the Corps of Engineers' offer was less than the lowest contractor proposal, but all the homeowners were able to negotiate an agreement within the Corps of Engineers' allowance. After the Homeowner-Contractor contract was executed, it was forwarded to the Corps of Engineers for review. This review was to insure that the fundamental requirements were covered (discussed in the next section), and other major

items of work were agreed upon, such as the size of porches and decks, sidewalks, driveways, and landscaping.

The last step prior to construction was execution of the Corps-Homeowner Agreement. It was very simple with only four requirements: 1) the house must be raised at least 1 foot above the 100-year flood elevation; 2) the construction must pass the codes inspection by the city of Goodlettsville (the prevailing code for home construction and improvement); 3) a provision for flow through the foundation was required to eliminate hydrostatic pressure; and 4) the homeowner must execute a covenant provided by the Corps and later recorded at the courthouse stating that the space below the new first floor would never be converted into living space. The Corps of Engineers paid the amount of the "offer" after the terms of the agreement were met. A sample agreement is included in *Appendix A*.

CONSTRUCTION

Description of Homes

All the homes in the program were one-story, brick veneer, in sound structural condition. The homes were about 1,000 to 1,475 square feet, and the raise heights ranged from 2 to 6 feet. All homes had crawl spaces under the main portion of the structure. Several residences had finished garages on slabs about 1.5 feet lower than the first floor; the slabs were not raised. Table 1, Dry Creek Flood Proofing Project Summary, presents a descriptive list of the homes.

TABLE 1

DRY CREEK FLOOD PROOFING PROJECT SUMMARY*

SIZE of HOUSE (sq. ft.)	RAISE HEIGHT (ft.)	CONST. COST**, ***	COMMENTS
1000	5.33	$26,200	3 exits
1000	6.00	$29,500	3 exits
1000	5.33	$29,500	3 exits
1000	4.67	$29,500	3 exits, A/C
1420	4.67	$35,000	3 exits, finished garage, offset
1450	4.00	$35,350	2 exits, A/C, fin. garage, offset, paved drive, big porch
1430	3.33	$34,050	2 exits, fin. garage, offset, fireplace, paved drive, 2 big porches
1475	4.00	$33,000	3 exits, offset
1425	3.33	$32,600	2 exits, garage, offset, paved drive,alum.siding, big front porch
1425	2.67	$31,000	2 exits, garage, offset, big front porch
1450	2.00	$30,800	2 exits, finished garage, large attached carport
1065	4.67	$29,700	2 exits, offset
1275	2.00	$30,200	2 exits, finished utility room (on slab), A/C, partial stone face
1450	2.00	$31,800	2 exits, finished garage w/ false ceiling, C/L fence
1400	2.00	$31,800	2 exits, finished garage w/ false ceiling, A/C
1450	2.00	$28,500	front porch, garage (rehang 2 doors & window, interior steps)
1014	2.00	$25,900	2 exits, paved driveway
1000	2.00	$27,200	2 exits, attached utility room,wood fence, concrete patio
1450	2.00	$31,600	2 exits, finished garage w/ false ceiling, large front porch

* Brick veneer houses in sound structural condition with crawl spaces.

** Includes $4,000 per structure for Corps of Engineers' administrative costs.

*** 1989-1990 prices.

Steps Involved

The steps and time requirements listed below were typical.

1. Building permit, and electrical and plumbing permits were obtained.

2. A pre-construction inspection and inventory was conducted by some contractors and homeowners at the Corps of Engineers' suggestion.

3. Site work in advance of house raising took from 3 to 5 days. This included brick removal and disposal, dismantling fences and moving shrubbery to allow access for the mobile equipment, knocking holes in the foundation walls and cutting garage slabs to allow placement of the house lifting beams, and other miscellaneous activities.

4. On the day of the actual house raising, water and sanitary drainage lines were disconnected, and the owners were asked to vacate the home.

5. The raising was usually accomplished with synchronized hydraulic jacking systems and timber cribbing. This activity took about 1 to 2 hours per vertical foot.

6. Temporary utility reconnections were made and temporary steps were built, thereby making the residence habitable. Many owners never spent a night out of their home. Local ordinances should be followed regarding habitability during housing raising activities.

7. The remainder of the work can be characterized as "normal" house construction activities such as new footings, masonry block laying, brickwork, plumbing, limited electrical work (meter bases were lowered), new porches and decks, and site cleanup and landscaping. The time involved for the construction varied greatly, from 2 weeks to 3 months. Factors impacting the time included weather, capability of contractor, availability of sub-contractors, and the type of structure.

Inspection, Approval, Payment

Since the contractor worked directly for the homeowner, the Corps of Engineers did not direct the work. The only formal "inspection" by the Corps of Engineers was to certify that the terms of the Corps-Homeowner agreement were met prior to payment. The Goodlettsville codes department provided the "quality control" for the construction (along with the homeowners). Payment was made by check and was issued jointly to the homeowner and the contractor for the amount specified in the Corps-Homeowner agreement.

COSTS

Raising-in-place construction costs for the 19 houses ranged from $25,900 to $35,350, including administrative cost. Table 1 on page 4 shows the cost of flood proofing each structure. The major variables that influenced the costs were the number of entrances/exits, height of raise and foundation perimeter, size of existing porches, offsets, and finished garages. Administrative costs of about $4,000 per structure were incurred. The administrative effort is discussed in the next section.

The applicability of using costs from this project as an estimating tool for potential projects is discussed in *Appendix B*.

RESPONSIBILITIES WITHIN THE CORPS OF ENGINEERS

1. The Real Estate Division verified ownerships, prepared the Corps-Homeowner Agreement, and recorded the flood proofing covenant that prevents the area below the new first-floor from being converted to living space (see example in *Appendix A*).

2. The Construction Division verified that the terms of the agreement had been fulfilled and processed the payment.

3. Cost Engineering helped measure the homes, evaluated their condition/situation and participated in the cost determinations.

4. The Engineering-Planning Division managed all aspects of the project including interaction with the Local Sponsor, the Homeowners, and other Corps of Engineers elements.

CONCLUSIONS

The Dry Creek Experience

The Dry Creek flood proofing project was a success. The project objectives were achieved — flood proof the houses in a cost efficient manner and maximize homeowner satisfaction.

There was nothing unique about flood proofing the houses along Dry Creek; no new construction techniques were developed, and no unusual techniques were used. The uniqueness of the project was the administrative philosophy. This philosophy was to "keep things simple, and stay out of the way as much as possible."

Unless there are special considerations, plans and specs are not required, and the Corps of Engineers' presence is not necessary to direct and inspect the work. A straightforward agreement was created with the necessary conditions to insure that flood proofing objectives were met. The Corps of Engineers allowed the homeowners to make decisions regarding their homes and work with the contractors of their choice. Cost efficiency was achieved by limiting the administrative cost throughout the process.

Customer satisfaction is always important, particularly when something as personal as raising an individual's home is undertaken. The best formula is to allow the homeowner as much freedom and flexibility as possible while maintaining control of the "Federal interest" — cost and project integrity.

The homeowners at Dry Creek included factory workers, bankers, single parents, elderly couples, and others. These homeowners were very happy with their decisions to raise their homes. Responses to a post-project inquiry indicated that all favored the high level of homeowner involvement that the project provided.

But Will It Work Anywhere Else?

Why wouldn't it? Differing conditions may require adjustments to the procedures presented here, but the philosophy is valid. As an example, the Corps of Engineers Nashville District is raising houses in a dramatically different area where there are no local codes, and many of the houses are in poor structural condition.

To accommodate that situation, the Corps of Engineers included funds for the homeowners to hire an engineer to facilitate the process. The engineer's role was to protect the homeowners' interest, certify that the construction meets the State Building Code, and provide other assistance as necessary. The additional cost of this procedural modification has been nominal.

The procedures used in the Dry Creek Project should be considered when cost efficiency and customer satisfaction are project objectives.

Figures 2 through 7 show examples of flood proofing in the Dry Creek Project.

Figure 2: Typical Home Raised About 2 Feet.

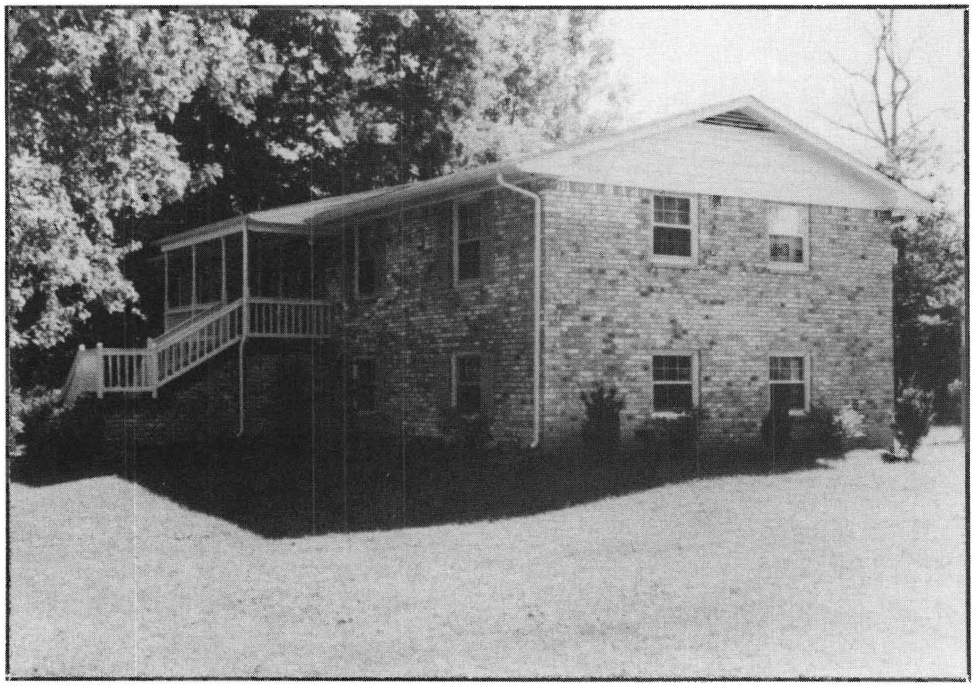


Figure 3: Typical Home Raised About 5 Feet.

Figure 4: Example Of A Home Raised With The Brick Veneer In Place — During Construction.

Figure 5: Example Of A Home Raised With The Brick Veneer In Place — Completion.

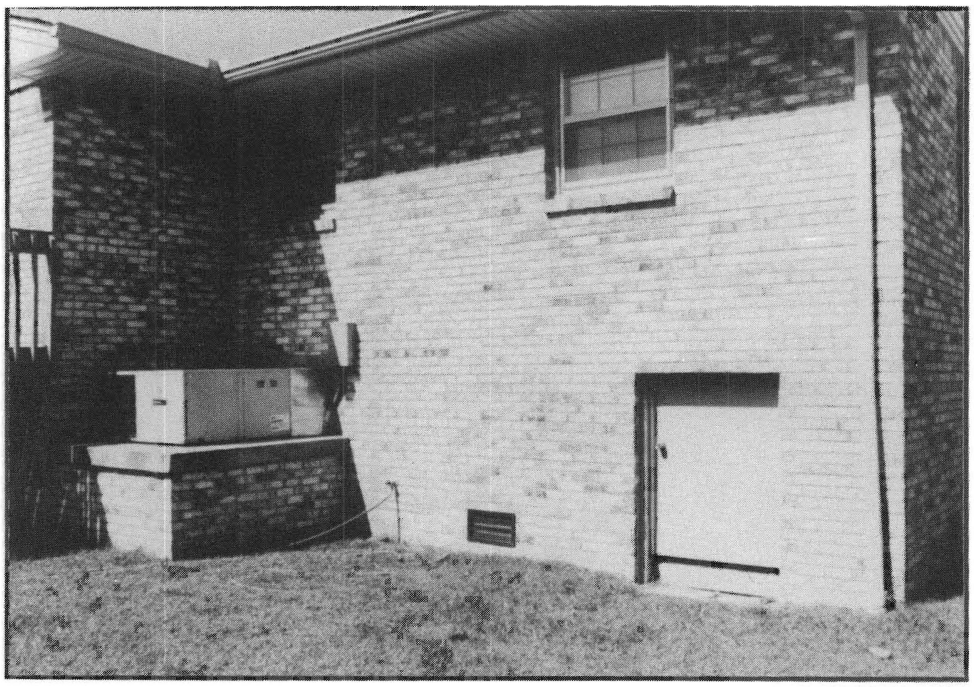


Figure 6: Provisions For Equalization Of Hydrostatic Head Was Accomplished With Foundation Vents And/Or Flexible Flaps On Crawl Space Access Door.

Figure 7: Example Of A Home Raised With Air Conditioner Compressor Unit On Elevated Platform.

Appendix A
Sample Documents

MESSAGE TO HOMEOWNERS

SUBJECT: ***RAISING HOMES IN PLACE .... GOODLETTSVILLE, TENNESSEE***

Under a joint Corps of Engineers-Metro program we plan to construct a weir on the west side of the Dry Creek culvert under I-65. This weir will reduce flooding in the Gateway subdivision but 19 homes might still get water inside the living area if a 100-year storm occurs. To prevent this we are offering to raise those 19 homes above that level. Your house at _____ is tentatively eligible to be raised ___ blocks (___-ft). Your participation is entirely optional.

If you think you would be interested, you will need to get at least 3 estimates for the work. **(Ask the contractors to put their estimates on the forms provided.)** Furnish all the bids you get to the Corps of Engineers. We will review the bids to identify the most reasonable. If that bid is low enough to conform with Corps economic guidelines, we will sign an agreement with you authorizing you to have the work done for which we will provide payment. When the work is complete we will issue a check payable jointly to you and the contractor.

To help you decide whether to participate, review the following guidelines:

1. This program is voluntary. You do not have to participate and you do not have to sign a contract until and unless you are satisfied on all matters and understand the program thoroughly.

2. Work closely with the prospective contractors so that the estimates represent plans that you are satisfied with. If a prospective contractor is not willing to conform to your requirements or our criteria seek another contractor.

3. We can only pay for work directly related to raising your home and restoring its appearance. If you want to use this opportunity to do some discretionary work (e.g., enlarge a room, finish a garage, or fence a backyard) you will need to work such things out (details and payment) between you and the contractor.

4. The Corps cannot pay for estimates. If the contractors cannot estimate the work free of charge, you will have to reimburse him. Be sure to ask if the estimate is free before you request it. You might get stuck with a bill you didn't expect.

5. Since our agreement will be between the Corps and you, and not the contractor, we cannot be responsible for his performance. Be sure to ask him about insurance, bonding, repair of any damages, warranty, etc., so you'll know up front what your options are. You may also want him to furnish references from previous jobs.

6. The Corps of Engineers will provide as much assistance and guidance as possible. We want you to be satisfied with the work and with your decision.

Call us anytime if you have a question at *(xxx) xxx-xxxx*; ask to speak with *Xxxx Xxxxx*.

MESSAGE TO CONTRACTORS

SUBJECT: ***RAISING HOMES IN PLACE .... GOODLETTSVILLE, TENNESSEE***

Under a joint Corps/Metro program, we are offering to pay for raising-in-place selected homes along Dry Creek. The owner of the home at _____is interested in our offer and is soliciting your estimate. Your estimate will be considered along with others as the basis for the owner selecting a contractor to do the job and for establishing a fair price for the work. You should work out a plan that satisfies the owner and conforms to Corps criteria. The owner will select the contractor and the Corps will determine what it will reimburse the owner for having the work performed. It is very important that your plan and estimate are thorough, accurate, responsive and sufficiently detailed for us to confirm the reasonableness of the costs that form the basis of your estimate.

If your company is selected for the work you will need to:

1. Obtain the required building permit(s) from the city of Goodlettsville;
2. Conform to all applicable codes;
3. Work out details and timing of operations with the owner including providing lodging for the occupant(s) if the property must be vacated;
4. Secure the property if it must be vacated;
5. Provide access at the worksite for Corps or Goodlettsville inspectors;
6. Provide a foundation that will allow free movement of floodwater beneath the house to equalize hydrostatic pressures;
7. Perform the work in a professional manner that you will be proud of, the owner will be satisfied with, and the Corps and Metro can pay for.

The Corps/Metro will pay for any and all operations necessary to raise the home at_____, _____ blocks (____ft.) and to restore the residence and lot to its pre-raised functionability, accessibility, and aesthetic value. In pursuit of these goals, the Corps will enter into an agreement with the landowner on a lump sum amount basis to cover all fair and reasonable costs. The Corps cannot pay for non-raising-related items or for damages. These, if any, must be worked out between you and the homeowner.

Upon completion of the work, the Corps will issue a check to the owner payable jointly to the owner and the Contractor in an amount set forth in the agreement between the owner and the Corps. Final payment from the Corps may take between 60 and 90 days after the work is certified as complete.

The attached estimate sheet is a sample format on which you can record your proposal. It includes items that may or may not be part of your plan. You may add or delete items but if you can present your bid in this or similar format it will make it easier for us to review.

ESTIMATING FORM

Proposal to Raise-in-Place the

Home at _____, _____Blocks (____ft.)

This sheet is only a guide. You may use it as is, revise it, or use something entirely different. However, this format makes it easier for us to evaluate your proposal, so use of this or similar sheet will expedite our review. Enter an amount after those items that are applicable. Put "N/A" after items that are not applicable and add any that are not shown. If you have questions call *Xxxxx Xxxxxx* at *(xxx) xxx-xxxx.*

Work Item	Equipment		Labor		Materials		Total
	Qty	Cost	Qty	Cost	Qty	Cost	
1. Coordinate work with public agencies and utility companies.	____	____	____	____	____	____	____
2. Obtain permit(s).	____	____	____	____	____	____	____
3. Inventory and inspect premises before & after job.	____	____	____	____	____	____	____
4. Insurance.	____	____	____	____	____	____	____
5. Security.	____	____	____	____	____	____	____
6. Warranty.	____	____	____	____	____	____	____
7. Disconnect and restore utilities (gas, electric, water, sewer, etc.).	____	____	____	____	____	____	____
8. Elevate house & attached garage (placement of beams, cribbing, jacking, etc.).	____	____	____	____	____	____	____
9. Elevate central A/C unit and associated equipment (ducts, condenser, etc.).	____	____	____	____	____	____	____
10. Elevate deck.	____	____	____	____	____	____	____
11. Lengthen downspouts.	____	____	____	____	____	____	____
12. Brickwork (remove and dispose existing brick, add new brick etc., as applicable).	____	____	____	____	____	____	____
13. Prepare and augment foundation to support house at new elevation (add courses of block, new vents, new access door, new foundation piers, etc.).	____	____	____	____	____	____	____
14. Augment steps, porches, stoops, etc., to restore full accessibility.	____	____	____	____	____	____	____

Work Item	Equipment		Labor		Materials		Total
	Qty	Cost	Qty	Cost	Qty	Cost	
15. Insulate under-house pipes against freezing if necessary, due to more open foundation.	____	____	____	____	____	____	____
16. Lodging for occupants if premises must be vacated.	____	____	____	____	____	____	____
17. Restore landscaping and site clean-up (seeding, grading, shrubs, fences, etc.).	____	____	____	____	____	____	____
18. Additional landscaping to mitigate raising effects (reduce foundation exposure, etc.).	____	____	____	____	____	____	____
19. Replacement/reinforcement of flooring members due to deterioration or structural deficiency - house cannot be raised in current condition.	____	____	____	____	____	____	____
20. Other (specify).	____	____	____	____	____	____	____
21. Profit (may be shown here or included in items above).	____	____	____	____	____	____	____

Attach sketches, details, narrative, other materials to help describe your plan.

TOTAL $

Signed_____

Position_____

Company Name_____

"CORPS - HOMEOWNER AGREEMENT"

Agreement No:_____

DRY CREEK FLOOD CONTROL PROJECT NON-STRUCTURAL PROGRAM PARTICIPATION AGREEMENT

THIS AGREEMENT, by and between the United States of America, acting through the U.S. Army Corps of Engineers, Nashville District, (Corps) and *XXXXX X. XXXXXXX* and wife, *XXXXXX X. XXXXXXX* (Owners),

WHEREAS, the United States of America and the Metropolitan Government of Nashville and Davidson County (Metro) have entered into a cooperative agreement for a flood control project on Dry Creek in Davidson County, Tennessee, under authority of Section 205 of the Flood Control Act of 1948, as amended, and the Water Resources Development Act of 1986 (Public Law 99-662); and,

WHEREAS, the Owners' residence at *XXX* Janette Avenue is eligible for flood proofing under the voluntary non-structural component of said flood control project, said residence being located on a tract of land described in a deed from *XXXXX X. XXXXX*, dated *XXXXXXX X*, 19*XX*, recorded in Book *XXXX*, page *XXX*, in the records of Davidson County, Tennessee; and,

WHEREAS, the Owners wish to participate in the non-structural program and receive the benefits of said flood proofing:

WHEREAS, the Owners have solicited estimates for performing work identified herein, and have furnished the Corps copies of all such estimates received,

NOW, THEREFORE, it is mutually agreed as follows:

1. The Owners agree to raise-in-place, consistent with approved building codes, the first habitable floor of the above-identified residence a minimum of *X.XX* feet above the present elevation, by the addition of foundation blocks in a manner which will permit the movement of flood waters beneath the structure to equalize hydrostatic pressures.

2. The Owners agree to execute a recordable instrument which will provide that no part of the raised structure below the level of the first habitable floor will be subsequently converted to living area for human habitation, or otherwise altered to impede the movement of waters beneath the structure.

3. The Owners agree to allow Metro or their authorized representatives access to their land and residence at all reasonable times to ensure that this agreement is being complied with by the Owners, their heirs and assigns.

4. All work shall be completed within 6 months from the date of this agreement. Upon completion of the work as set forth above and inspection by the Corps and delivery to the Corps of:

(a) an invoice for payment,

(b) a certificate that the construction meets applicable building codes, and

(c) the executed recordable instrument set forth in paragraph 2,

the Corps agrees to issue a check from available project funds, payable jointly to the Owners and *XXXXXXX XXXXXXXX XXXXXXXXXXXX*, the Owners' contractor, in the amount of $*XX,XXX* as full consideration therefor.

5. The Owners agree to accept said sum in full satisfaction and in complete discharge of all obligations of the United States under this agreement.

6. The Owners agree that unforeseen or unanticipated conditions encountered during performance of the work shall be immediately brought to the attention of the Corps. After investigation, and subject to a determination that such conditions should not have been anticipated and were outside the control of either the Owners or their Contractor, the Corps may consent to an equitable supplementation and modification of this agreement for any costs of performance increased thereby.

7. The Owners agree that they may void this agreement without penalty at their option but that in so doing they will receive no payment from the Corps. Payment will be made only upon completion of the work and as stipulated in paragraph 4 above.

8. The Owners agree to forever save and hold harmless the United States of America and its assigns from all claims for damages of any kind arising from or attributable to the flood proofing work authorized under this agreement.

EXECUTED this the_____day of_____, 19 __ .

_____ _____

XXXXX X. XXXXXXXXX *XXXXXX X. XXXXXXXXX*

ACCEPTED on behalf of the United States of America, this the_____day of _____, 19__ .

By:_____
Xxxxx Xxxxxxxxx
(Contracting Officer)
U.S. Army Engineer District
Nashville, Tennessee

APPROPRIATION:
XXXXXXX XXXXXXXXXXXXXXX (XX)(XXXX) XXX-XXX - $*XX,XXX* (FEDERAL)
XXXXXXX XXXXXXXXXXXXXXX (XX)(XXXX) XXX-XXX - $ *X,XXX* (SPONSOR)

DRY CREEK FLOOD CONTROL PROJECT
FLOOD PROOFING COVENANT

WHEREAS, the United States of America, acting through the Nashville District, Corps of Engineers, and the Metropolitan Government of Nashville and Davidson County have entered into a Local Cooperation Agreement for flood control on Dry Creek; and

WHEREAS, the residence located at *XXXXXXXXXXXXXXXXXXXXXXXX*, Goodlettsville, Tennessee, is eligible for raising-in-place in connection with said Project; now, therefore;

FOR AND IN CONSIDERATION of the benefits to be derived from participation in said Project, We, *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX*, the owners of said residence, do hereby promise and covenant that on completion of said raising-in-place, no part of the raised residence located below the level of the first habitable floor will thereafter be converted to living area for human habitation, or otherwise altered in a manner which would impede the movement of waters beneath the structure.

The residence identified above is located on the land described in a deed from *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* to *XXXXXXXXXXXXXXXXXXXXXXXXXXXX*, dated *XXXXXXXXXXXXXXXXX*, recorded in Book XXXX, page XXX, in the records of Davidson County, Tennessee.

The promise and covenant made herein shall run with the land, and shall be binding on our heirs, successors, and assigns. We further agree to permit the future inspection of said land and residence by authorized representatives of the implementing agencies as required to assure compliance with this promise.

WITNESS OUR HANDS, this_____day of_____, 199*X*.

_____

XXXXXXXXXXXXXXXXXX

_____

XXXXXXXXXXXXXXXXXX

STATE OF TENNESSEE

COUNTY OF DAVIDSON

Personally appeared before me, a Notary Public in and for the state and county above mentioned, *XXXXXXXXXXXXXXXXXXXXXXXXXX*, the within named promisors, with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence) and who acknowledged that they executed the foregoing instrument for the purposes stated therein.

This the_____day of _____ , 199*X*.

_____

Notary Public

My Commission expires: _____

Appendix B

Using Dry Creek Costs as an Estimating Tool

General

The purpose of this report was to document the administrative procedures that were successfully used for the Dry Creek flood proofing project. Those procedures, and the general philosophy of maximizing homeowner involvement, are probably valid for all house raising projects; however, the costs are project specific and have not been tested for application elsewhere. The purpose of this appendix is to discuss the applicability of using the cost data included herein as a basis for estimating costs on similar projects at other locations.

Discussion

As discussed in this report, the homes on Dry Creek were structurally sound, brick veneer, one-story homes with crawl spaces. The homes ranged from 1,000 to 1,475 square feet. Building materials and skilled labor were readily available, and there was a competitive environment within the local contractor community. This does not mean that the Dry Creek costs are not representative, it means that extracting cost data from this project for use elsewhere should be done with caution and with an understanding of the applicability of such cost data.

A number of factors impact the cost of flood proofing a home, some include: size of structure, height of raise, condition of the home, number of entrances, size of porches, fireplaces, type of construction (brick veneer vs. frame), access, additions or offsets, and others. For homes in fair condition or better (no serious structural deficiencies), the dominant factors are usually the size of the home and the raise height. After the Dry Creek flood proofing project was completed, the cost data was evaluated to see if any meaningful relationships could be derived that might be used as a planning-level estimating tool. An equation was developed based on the Dry Creek house raising costs. The variables in the equation are size of structure and raise height, and the equation takes the form:

COMPUTED COST = K + (K_s)(size) + (K_h)(raise height). Constants are ***K; K_s***, *"size" is the square feet of the ground floor, including attached garage*; and ***K_h***, *"raise height" is in feet.*

The constants derived from the Dry Creek data are:

K=11,360 ; K_s=12.6; and **K_h=970.**

The following Cost Analysis Table shows the actual cost, the computed cost using this formula, and the percent of difference for each house raised in the Dry Creek Project.

The above equation should give reasonable planning-level estimates for screening alternatives. Anyone using the equation or its results should recognize the limitations of this method.

THE EQUATION SHOULD NOT BE APPLIED TO SITUATIONS WHICH ARE DRASTICALLY DIFFERENT FROM THOSE AT DRY CREEK. SPECIFICALLY, THE EQUATION SHOULD NOT BE USED ON HOMES IN POOR (UNSOUND) CONDITION OR HOMES ON SLAB.

COST ANALYSIS TABLE

STRUCTURE NUMBER	SIZE (square feet)	RAISE HEIGHT (feet)	ACTUAL COST*	COMPUTED COST**	PERCENT DIFFERENCE (Computed vs. Actual)
1	1000	5.33	$26,200	$29,130	+10
2	1000	6.00	$29,500	$29,780	+ 1
3	1000	5.33	$29,500	$29,130	- 1
4	1000	4.67	$29,500	$28,490	- 4
5	1420	4.67	$35,000	$33,782	- 4
6	1450	4.00	$35,350	$33,510	- 5
7	1430	3.33	$34,050	$32,608	- 4
8	1475	4.00	$33,000	$33,825	+ 2
9	1425	3.33	$32,600	$32,545	0
10	1425	2.67	$31,000	$31,905	+ 3
11	1450	2.00	$30,800	$31,570	+ 2
12	1065	4.67	$29,700	$29,309	- 1
13	1275	2.00	$30,200	$29,365	- 3
14	1450	2.00	$31,800	$31,570	- 1
15	1400	2.00	$31,800	$30,940	- 3
16	1450	2.00	$28,500	$31,570	+10
17	1014	2.00	$25,900	$26,076	+ 1
18	1000	2.00	$27,200	$25,900	- 5
19	1450	2.00	$31,600	$31,570	0

* 1989-1990 Costs, includes $4,000 per structure for Corps of Engineers' administrative costs

** Computed Cost Where K = 11,360; K_s = 12.6; K_h = 970

EXAMPLE:

House No. 5:

COMPUTED COST = K+(K_s)(size of house in square feet) + (k_h)(raise height in feet)

= 11,360 + (12.6)(size of house) + (970)(raise height)

= 11,360 + (12.6)(1420) + (970)(4.67)

= $33,782

*U.S. GOVERNMENT PRINTING OFFICE:1995-674-455-25031