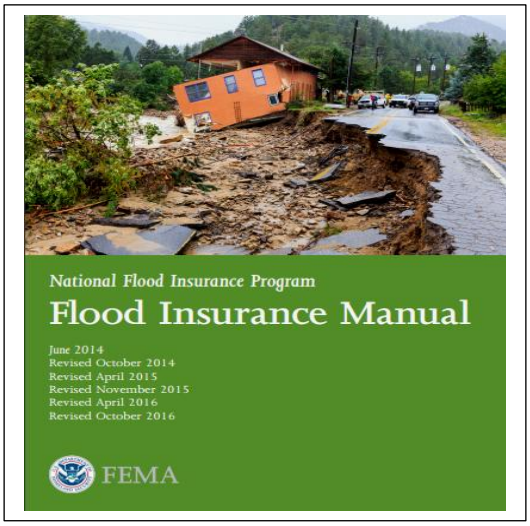
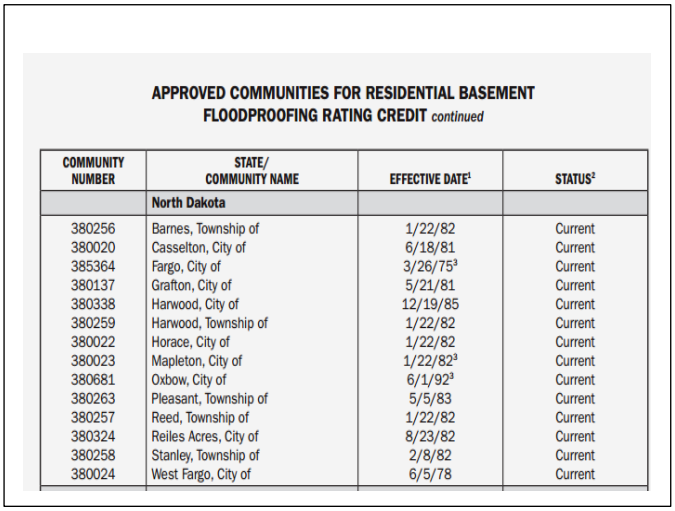
National Flood Insurance Program

Fargo Basement Exemption (Rating Credit) Federal Authorization





APPROVED COMMUNITIES FOR RESIDENTIAL BASEMENT FLOODPROOFING RATING CREDIT *continued*

COMMUNITY NUMBER	STATE/ COMMUNITY NAME	EFFECTIVE DATE[1]	STATUS[2]
	North Dakota		
380256	Barnes, Township of	1/22/82	Current
380020	Casselton, City of	6/18/81	Current
385364	Fargo, City of	3/26/75[3]	Current
380137	Grafton, City of	5/21/81	Current
380338	Harwood, City of	12/19/85	Current
380259	Harwood, Township of	1/22/82	Current
380022	Horace, City of	1/22/82	Current
380023	Mapleton, City of	1/22/82[3]	Current
380681	Oxbow, City of	6/1/92[3]	Current
380263	Pleasant, Township of	5/5/83	Current
380257	Reed, Township of	1/22/82	Current
380324	Reiles Acres, City of	8/23/82	Current
380258	Stanley, Township of	2/8/82	Current
380024	West Fargo, City of	6/5/78	Current

U.S. Department of Homeland Security
Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO. 80225-0267

R8-MT

FEMA

January 27, 2015

The Honorable Tim Mahoney
Mayor, City of Fargo
200 3rd Street North
Fargo, North Dakota 58102

Dear Mayor Mahoney:

This letter is to inform you that the reevaluation of the current basement exception for the City of Fargo, North Dakota, has been approved. The City may continue to allow the construction of floodproofed residential basements below the Base Flood Elevation (BFE) in areas of special flood hazard that meet the criteria in Title 44 Code of Federal Regulations (CFR) Part 60.6(b) of the National Flood Insurance Program (NFIP) regulations.

As you are aware, the City of Fargo has had an exception to FEMA's minimum NFIP floodplain management criteria since March 26, 1975. The basement exception, which was granted pursuant to 44 CFR Part 60.6(b), allows the City to construct floodproofed residential basements below the BFE, a non-federal action. The base flood elevation is the height of the flood having a 1-percent chance of being equaled or exceeded in any given year.

FEMA has reviewed the request from the City of Fargo. As specified in 44 CFR 60.6(b), FEMA has reviewed the submittal based on the requirements within the regulations, to include performing an environmental review. FEMA has determined that the continuation of the basement exception in the City of Fargo complies with the requirements set forth in FEMA's aforementioned regulations. Additionally, FEMA has determined this exception does not individually or cumulatively have a significant impact on the human environment and would require no additional environmental or historic preservation review by FEMA.

If you have any questions, please contact John LaBrune, Floodplain Management and Insurance Branch Chief, at (303) 235-4906 located in the FEMA Region VIII Office in Denver, Colorado.

Sincerely,

Jeanine Petterson, Director
Flood Insurance and Mitigation Division

cc: Home Builders Association of Fargo-Moorehead
Ron Strand, Floodplain Administrator, City of Fargo
Nathan Boerboom, City of Fargo Engineering Department
April Walker, City of Fargo Engineering Department
The Honorable Governor Dalrymple, North Dakota
L. David Glatt, North Dakota Department of Health
Daniel E. Cimarosti, Army Corps of Engineers
Hali A. Durand, Cass County Highway Department
North Dakota State Water Commission
Merlan E. Paaverud, North Dakota State Historical Society
Senator John Hoeven, U.S. Senate
Senator Heidi Heitkamp, U.S. Senate
Congressman Kevin Cramer, U.S. House of Representatives

U.S. Department of Homeland Security
500 C Street, SW
Washington, DC 20472

JAN 2 2 2015

FEMA

The Honorable John Hoeven
United States Senate
Washington, DC 20510

Dear Senator Hoeven:

Thank you for your letter dated December 1, 2014, to Craig Fugate, Administrator of the Federal Emergency Management Agency (FEMA), Department of Homeland Security. You expressed support regarding the request by the City of Fargo, North Dakota, for reevaluation of the current basement exception.

As you know, the City of Fargo, North Dakota, has had an exception to FEMA's minimum National Flood Insurance Program (NFIP) floodplain management criteria since March 26, 1975. The basement exception, which was granted pursuant to 44 Code of Federal Regulations (CFR) Part 60.6(b), allows the City of Fargo to construct floodproofed basements below the base flood elevation, a non-federal action. The base flood elevation is the height of the flood having a 1-percent chance of being equaled or exceeded in any given year.

FEMA has received and reviewed the request from the City of Fargo. As specified in 44 CFR Part 60.6(b), FEMA has reviewed the submittal based on the requirements within the regulations, to include performing an environmental review. FEMA has determined that the continuation of the basement exception in the City of Fargo complies with the requirements set forth in FEMA's aforementioned regulations. Additionally, FEMA has determined this exception does not individually or cumulatively have a significant impact on the human environment and would require no additional environmental or historic preservation review by FEMA.

I hope this information is helpful to you in addressing the concerns of your constituents. If you need additional assistance, please have a member of your staff contact the FEMA Congressional Affairs Division by telephone at (202) 646-4500.

Sincerely,

Roy E. Wright
Deputy Associate Administrator for Mitigation
Federal Insurance and Mitigation Administration

U.S. Department of Homeland Security
500 C Street, SW
Washington, DC 20472

JAN 2 2 2015

FEMA

The Honorable Heidi Heitkamp
United States Senate
Washington, DC 20510

Dear Senator Heitkamp:

Thank you for your letter dated December 1, 2014, to Craig Fugate, Administrator of the Federal Emergency Management Agency (FEMA), Department of Homeland Security. You expressed support regarding the request by the City of Fargo, North Dakota, for reevaluation of the current basement exception.

As you know, the City of Fargo, North Dakota, has had an exception to FEMA's minimum National Flood Insurance Program (NFIP) floodplain management criteria since March 26, 1975. The basement exception, which was granted pursuant to 44 Code of Federal Regulations (CFR) Part 60.6(b), allows the City of Fargo to construct floodproofed basements below the base flood elevation, a non-federal action. The base flood elevation is the height of the flood having a 1-percent chance of being equaled or exceeded in any given year.

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I hope this information is helpful to you in addressing the concerns of your constituents. If you need additional assistance, please have a member of your staff contact the FEMA Congressional Affairs Division by telephone at (202) 646-4500.

Sincerely,

Roy E. Wright
Deputy Associate Administrator for Mitigation
Federal Insurance and Mitigation Administration

CITY OF Fargo

Mayor Dennis R. Walaker
200 3rd Street North
Fargo, North Dakota 58102
Phone (701) 241-1310
Fax (701) 476-4136

November 25, 2014

Mr. Ryan Pietramali
Risk Analysis Branch Chief
Denver Federal Center
Building 710
Denver, CO 80225-0267

Re: Residential Floodproofing Rating Credit, Fargo, ND

Dear Mr. Pietramali:

The City of Fargo is excited to be at the end of the floodplain mapping update process and is currently completing the last few tasks necessary prior to the effective date of January 16, 2015 for these new maps. Once effective, we believe these maps will provide the City additional tools that can be utilized in more effectively managing our floodplain, which will hopefully allow for us to reduce the risk of flooding we experience here in the Red River Valley.

One task that our staff has recently completed and that I am proud to present to you is a document detailing why we believe the City of Fargo should be provided the opportunity to continue its Residential Floodproofing Rating Credit (basement exception) with the Federal Emergency Management Agency (FEMA). Since 1975, when the City received approval for the basement exception from FEMA, it has become an effective mitigation tool that has guided construction methods for basements within the City. This has resulted in basements that have withstood numerous record and near record floods without one failure, which have saved property owners from potential substantial property losses.

We believe that the continuation of constructing floodproof basements in Fargo is an effective way to mitigate potential damage while also maintaining the affordability of homeownership for our residents.

The City of Fargo is looking forward to working with FEMA in their review of this submittal so please do not hesitate to contact our City staff with any questions that may need to be addressed during the review process.

Sincerely,

Dennis R. Walaker
Mayor

DRW:se
ww14FEMAbasementexception

cc: Mark Bittner, City of Fargo Director of Engineering
April Walker, City of Fargo City Engineer
Nathan Boerboom, City of Fargo Floodplain Coordinating Engineer
Ron Strand, City of Fargo Floodplain Administrator
Barb Fitzpatrick, FEMA
Senator John Hoeven, U.S. Senate
Senator Heidi Heitkamp, U.S Senate
Congressman Kevin Cramer, U.S. House of Representatives

Residential Floodproofing Rating Credit
(Basement Exception)

for

Floodproofed Basements

REGISTERED PROFESSIONAL ENGINEER
APRIL E. WALKER
PE - 5462
DATE 11-25-14
NORTH DAKOTA

April Walker, PE, CFM
City Engineer

11/25/14
Date

City of Fargo, ND
Engineering Department
200 3rd Street North
Fargo, ND 58102

Table of Contents

1. Introduction

Since the late 1990's, the Federal Emergency Management Agency (FEMA) has been in the process of revising the current effective Flood Insurance Study (FIS) on the Red River of the North within Cass County, ND. The City of Fargo is located within Cass County and has been participating with FEMA throughout the process of updating the FIS. FEMA has recently indicated that the preliminary FIS will become effective on January 16, 2015 and therefore the City of Fargo has been working on updating its floodplain management policies and requirements prior to the adoption date. One of these management items is the renewal of the basement exception with FEMA. The intent of this document is to provide a basis for continuation of the basement exception within the City of Fargo. Chapter 60.6c of the Code of Federal Regulations was used as guidance for preparing this document.

2. Background

2.1 – Fargo, ND

The City of Fargo is located in the southeast corner of North Dakota on the western bank of the Red River of the North. Fargo is the largest city in North Dakota, with a current population of 113,000 and is the core city of the Fargo-Moorhead metropolitan area. Fargo is the regions center for economic growth and is currently experiencing strong growth rates in the areas of agriculture, healthcare, higher education, manufacturing, technology and retail. It is also a major transportation hub for the region with two interstates crossing, Burlington Northern railways intersecting and an international airport.

Fargo originally entered into the National Flood Insurance Program (NFIP) in 1976 and the Community Rating System (CRS) in 2006. The current class rating of Fargo within CRS is a 7.

Common building practice within the region is to have residential structures include basements due to numerous factors such as: climate, soil characteristics and life safety. Later within this document there will be a discussion on how climate and soil characteristics make basement construction necessary as well as the most feasible construction method. But one component that basements provide that should not be overlooked, is a safe area for residents to take shelter during severe summer weather, such as tornados. Cass County, which Fargo is located in, has experienced 91 reported tornadoes in the last 63 years, which is the highest frequency of such events in the state of North Dakota. Cass County has also experienced over 135 thunderstorm and wind events in the last 13 years. This shows that the region is at high risk for potential damaging severe summer weather that could put life safety at a higher risk if basements were not part of the building practice. This is why the State of North Dakota's Hazard Mitigation Plan includes basements as a form of mitigation against these types of severe weather storms.

2.1 – Red River of the North

As previously mentioned, the City of Fargo is located on the western bank of the Red River. The Red River is formed at the confluence of the Otter Tail and Bois de Sioux Rivers, which is at the cities of Wahpeton, ND and Breckenridge, MN. The Red River flows north forming the boundary between the states of North Dakota and Minnesota and ultimately discharges into Lake Winnipeg in Manitoba, Canada. The basin of the Red River within the United States drains approximately 40,070 square miles. The valley of the Red River was once the bed of glacial Lake Agassiz and the resulting terrain is extremely flat and prone to flooding. Since the valley is so flat, during periods of high water on the Red River the floodwaters are able to spread out and inundate miles of adjacent land to the river. The National Weather Service has designated a river gage elevation within Fargo of 18-feet as minor flood stage. This elevation has been exceeded by the Red River in 50 of the past 111 years. It was exceeded consecutively from 1993 to 2011, and again in 2013 and 2014. The flood of record on the Red River within Fargo occurred in 2009 reaching a

river gage level of 40.84-feet. Recently Fargo has been experiencing some of the highest floods on record, with four of the seven highest occurring since 2006.

3. General Information

3.1 – Fargo's Floodplain Management

Due to the previously discussed flooding concerns on the Red River, the City of Fargo takes a proactive role in floodplain management. The City has ordinances, policies, permits, and programs that all work in conjunction with each other to form a comprehensive approach to floodplain management. All these activities have the same goal in mind of protecting the residents of Fargo while allowing the river to function. The following is a summary of items that are part of Fargo's floodplain management tools:

a. Ordinances

The City has ordinances in place for various floodplain management activities. The most restrictive of these is the watercourse setback ordinance (#4818). This ordinance sets minimum distances from the centerline of the Red River and Sheyenne River that limits what type of land disturbance activities are allowed within these setback areas. The ordinance essentially restricts any man-made change to improved or unimproved real estate unless such development conforms to the regulations spelled out within the ordinance. See Appendix A for full version of ordinance.

The City also monitors areas along the river for possible encroachments that are not permissible under our ordinances. Any encroachments reported by our citizens or found by City staff are inspected and violations are issued until the encroachment is removed.

The basis of this ordinance was to provide an appropriate setback that accounts for the natural phenomena that occur in proximity of the Red River such as inundation, and mass slumping. The Red River of the North and its tributaries have soils that from an engineering perspective are weak and have a high plasticity. Development activities that are too close to the riverbank create structures that are susceptible to the natural instability. Engineered solutions are limited and cost prohibitive. The preferred course of action is to avoid development of this area. Therefore the City has adopted a setback ordinance that attempts to generalize the angle of repose that the riverbank wants to achieve, measured from the bottom of the river to the top of the flood protection elevation desired. This slope is approximately 8:1 which has been generalized for ease of enforcement, to the greater of 450' (on the Red River and Wild Rice River) from the river centerline or a 100' setback from the floodway. On the Sheyenne River it is the greater of 175' from the river centerline or a 100' setback from the floodway

b. Building Requirements

The City has a policy in place that requires all residential structures located within the 41-foot water surface elevation inundation area (WSEIA) to be constructed per the City's floodproofing construction requirements. The minimum lowest point of risk on these residential structures is required to be 1.2-feet above the 41-foot WSEIA. For reference the FIS that is set to become effective on January 16, 2015 is based on a river gage elevation of 39.4-feet for the 1% annual chance flood elevation within Fargo. Commercial properties within the City are also required to be elevated so that their point of risk is also at or above these same elevations. The most recent revision of this policy occurred in March 2014. It is the City's intent to revise this policy again with the new basement structural requirements after FEMA's review of the City's request for

continuation of the basement exception. See Appendix B for a copy of Fargo's Floodproof Construction Requirements, which includes the proposed revisions to include the structural revisions.

Along with these building requirements, we also require all new subdivision plats that may have all or portions of the plat located within the Special Flood Hazard Area (SFHA) to elevate the lots with fill to at or above the 1% annual chance floodplain. The placement of this fill does not eliminate the need for the structures to be constructed per our floodproofing requirements.

c. Levee Systems

There are numerous levee systems throughout the city that provide protection to our residents from flood waters. Some of these levees are complete systems that are either accredited by FEMA or in the process of being accredited. As of the date of this report, the City has one levee system that is accredited by FEMA as providing protection against the 1% annual chance flood, one that is currently a Provisionally Accredited Levee System (PALS) that is undergoing some maintenance in order for it to continue to be accredited and one that has been recently submitted for accreditation.

The City is also taking a very aggressive approach to completing levees throughout the City. This aggressive approach is being done with two goals in mind. The first goal is to provide real protection that will reduce the City's reliance on temporary emergency clay levees during a flood fight. The second is to construct all levees to FEMA standards that will allow for future accreditation once enough levees are constructed to create a continuous line. These levees are all being built with proper freeboard to provide protection against the new FIS. In order to construct these levees, the City has been allocating $30 million dollars a year of local funds towards acquisitions and levee, floodwall and storm sewer lift station construction.

d. Property Acquisitions

As previously mentioned the City has been actively purchasing at-risk properties and removing the structures. Since 1990, 325 properties have been purchased with 172 occurring after the 2009 flood. These acquisitions have resulted in the majority of the City's repetitive loss structures to be removed. Currently only three repetitive loss properties remain.

e. Interior Flood Concerns

The City is not only actively managing the floodplain due to the Red River but also planning and implementing measures for significant rainfall events. To help reduce potential damages from this type of flooding, we require that all new residential and commercial additions install retention facilities that control the rate of runoff and volume leaving a site on a 10 and 100 precipitation frequency reoccurrence intervals. This is also a requirement that any redevelopment site over an acre must meet.

To further reduce the potential damages during both a heavy rainfall event as well as any rainfall during periods of high water on the river, 76 storm sewer lift stations are installed throughout the City. These lift stations have permanent pumps that automatically turn on when the water levels reach a specified height in the lift stations. The City has a Storm Water Management Model (SWMM) model of almost the entire City storm sewer system. This model is used during design of various storm sewer projects within the city, which allows for a review of any improvements made to the system so that they do not adversely impact the capacity of the entire storm sewer system. This results in an efficient use of available funds when planning for future projects.

f. Public Outreach

The last crucial component of the City's floodplain management tools is public outreach. We continually meet with various organizations such as the Home Builders Association, realtor groups, insurance agents, lenders and others. We also do multiple articles in the City quarterly newsletter that goes out to all residents within Fargo as well as items within the media. Other examples of the City's outreach tools are: City maintained website called fargofloodinsurance.com, billboards, annual "Be Flood Aware" inserts in to property owner utility bills and direct mailings to over 100 insurance agents, lenders and real estate agencies. The awareness and desire of Fargo citizens to learn more about their flood risk can also be seen by the number of individuals that contact the City on an annual basis. Annually we receive over 400 calls and make approximately 50 individual site visits to property owners that have questions or concerns regarding their property.

All these tools provide multiple contacts with people throughout the year so that everyone is aware of the flood risk the City is at.

3.2 – Existing Basement Exception

In 1975, the City of Fargo adopted the flood proofing code for guidance on building construction with the City. This flood proofing code was the original document that allowed Fargo to receive its basement exception from FEMA at a later date. While this code is still in place, there have been modifications to it over time by ordinance, policy or changes in International Building Code. This basement exception renewal document is not intended to replace the adopted flood proofing code but instead supplement it.

The City has multiple steps in place that make certain that these floodproof basements are properly constructed and meet the minimum point of risk elevations required by the City. These requirements start from the initial issuance of the building permit and continue up to the final grading around the structure. The following outlines the process in 6 steps:

1. Builder applies for building permit. Permit application must have structural drawings and residential floodproofing certificate.
2. Pending a complete permit application, City of Fargo Inspections Department issues building permit and notifies Engineering Department of need for elevation grade stake for property.
3. Engineering Department verifies proper elevation on residential floodproofing certificate and sends survey crew out to set elevation grade stake.
4. During foundation and basement wall construction, Inspections Department completes a total of seven different inspections. Standard basement construction only requires two inspections. The seven inspections are: footing, foundation, waterproofing, drain tile, sewer line, sewer valve, concrete floor.
5. Once grading is completed around structure, builder notifies Inspections Department and they request the post-construction survey from the Engineering Department.
6. Engineering Department completes post-construction survey and issues Elevation Certificate to property showing point of risk as the lowest opening of the structure.

The success of the flood proofing code and associated revisions has been well documented throughout the region. There have been no documented failures of a floodproofed basement. Further information on the success of these floodproof basements can be seen in the document "28 Years of Successful Floodproofing in the Red River Valley of

North Dakota and Minnesota" (prepared by Bruce Langness, PE, CFM and Joel Quanbeck, AICP, 2003). This document can be found in Appendix C.

4. Basement Exception Documentation

4.1 – Code of Federal Regulations

This next section is intended to provide information on how the City of Fargo is continuing to meet or exceed the standards for floodproofed basements as laid out in 44 CFR 60.6c. The following is a breakdown of each item within the CFR and how it relates to the City of Fargo:

- *The community has demonstrated that areas of special flood hazard in which basements will be permitted are subject to shallow and low velocity flooding and that there is adequate flood warning time to ensure that all residents are notified of impending floods. For the purposes of this paragraph flood characteristics must include:*
  - *Flood depths that are five feet or less for developable lots that are contiguous to land above the base flood level and three feet or less for other lots.*

    Majority of flood depths within City limits are less than five feet and are contiguous to land above the base flood elevation due to the previously discussed City policy that requires residential lots to complete a LOMR-F on any property that is located within the SFHA. Generally, areas that exceed five-feet in depth are not buildable due to proximity to drains and rivers, which these areas would fall under the previously discussed City ordinance #4818, Watercourse Setbacks. The previously mentioned Floodproof Construction Requirements policy also has a provision within it that does not allow for placement of more than 5-feet of fill unless the fill is engineered and designed by a Licensed Professional Engineer.

    The flood depths associated with the 1% annual chance floodplain can be seen in the map, dated June 13, 2014, found in Appendix D, as provided from FEMA.

  - *Flood velocities that are five feet per second or less.*

    The flood velocities on the Red River during a 1% annual chance flood are all less than five feet per second. Majority of the velocities are less than three feet per second. The few areas that exceed three feet per second are all contained within the floodway, where structures are prohibited under ordinance #4818, Watercourse Setbacks.

    The flood velocities associated with the 1% annual chance flood can be seen in the mapping found in Appendix E. This mapping was created by Houston Engineering on October 16, 2014.

  - *Flood warning times that are 12 hours or greater. Flood warning times of two hours or greater may be approved if the community demonstrates that it has a flood warning system and emergency plan in operation that is adequate to ensure safe evacuation of flood plain residents*

    Historically the Red River is not susceptible to flash flooding levels that would put structures at risk. The Red River has only reached levels that could pose a threat to structures during a spring flood

event that was due to snow melt. During a spring flood, the river takes multiple days to react and reach the levels that could provide threat to safety of the flood plain residents.

During a spring flood the City utilizes numerous methods to keep our residents informed. These methods include daily televised meetings and briefings anytime the river is higher than a gage level of 35-feet. The City also has a Code Red notification system in place for any emergencies. This Code Red system is a database of phone numbers and addresses that can be used to target specific areas of town to mass notify residents through telephone call and cell phone texts.

A chart of multiple past hydrographs of the Red River during a spring flood has been provided in Appendix F. From this chart it is able to be seen that the quickest the river has ever reached a level that could pose a threat to human safety was seven days, occurring in 1969 and 2006.

- *The community has adopted floodplain management measures that require that new construction and substantial improvements of residential structures with basements in zones A1-30, AH, AO and AE shall:*

  Be designed and built so that any basement area, together with attendant utilities and sanitary facilities below the floodproofed design level, is watertight with walls that are impermeable to the passage of water without human intervention. Basement walls shall be built with the capacity to resist hydrostatic and hydrodynamic loads and effects of buoyancy resulting from flooding to the floodproofed design level, and shall be designed so that minimal damage will occur from floods that exceed that level. The floodproofed design level shall be an elevation one foot above the level of base flood where the difference between the base flood and the 500-year flood is three feet or less and two feet above the level of the base flood where the difference is greater than three feet.

The structural design of Fargo's floodproof basement accounts for the hydrostatic and hydrodynamic loads as well as the buoyancy effects that could be expected to be experienced on these walls and floors during a typical 1% annual chance flood. The structural design is actually done in such a manner that the flood water can be to the top of the basement walls without the walls collapsing and as previously mentioned, the City has minimum elevation requirements for the top of these walls that exceed the minimum requirements of 1-foot above the BFE (Fargo river gage of 39.4'). Fargo's minimum elevation requirement is 1.2-feet above the 41' WSEIA. See Appendix G for the full structure design report, as prepared by KLJ.

The utilities that penetrate the floor are in place at the time of original concrete installation, which results in them being integral to the floor and having a continuous contact around the perimeter of the pipes. The City also has within the floodproofing code, the requirement that all sanitary sewer services must have a check valve in place prior to penetrating above the basement floor. This valve operates without any human intervention and prevents any water from backing up through the service line.

As previously discussed, Fargo has elevation requirements in place that requires the floodproofed design level to be at least 1.2-feet above the 41' water surface elevation inundation area (WSEIA), which would result in the floodproofed level to be approximately 2.5-feet to 3-feet above the base flood elevation (BFE). New BFE is an approximate river stage of 39.4-feet.

- *Have the top of the floor of any basement area no lower than five feet below the elevation of the base flood.*

  The prevalent construction type of residential structures within Fargo no longer meets this requirement when compared against the BFE becoming effective in January 2016. This requirement could be met, but it would result in significantly higher construction costs. The major item that would result in additional cost is associated with the footing of the structure.

  The climate Fargo is located in requires the footings for a structure to be at least 4-feet in the ground to be below an average frost depth level. However, the requirement that these footings be on undisturbed clay material has become the controlling factor due to the new BFE and associated structure elevation requirements. This requirement is resulting in these footings getting placed closer to six feet below the BFE. This is due to the depth of topsoil (average depth of 18 to 24-inches) being needed to be removed and then the lots being on average of four feet below the BFE. Typical construction practice has the basement floor installed directly above the top of the footing resulting in these basement floors being more than 5-feet below the BFE. It is possible to elevate the basement floor height but as previously mentioned the result of this could make purchasing homes in Fargo cost prohibitive for a larger portion of our population base. To gain a better understanding of what these additional costs would be, we asked the Fargo-Moorhead Home Builders Association to provide some information on what a typical increase in construction cost would be for having the footings at the same elevation (still need to be on undisturbed clay), elevating the basement floor and the associated increase in wall heights due to raising the floor. This information can be seen in Appendix H.

  Historically, the five-foot maximum depth below the BFE for a basement wall was able to be met within Fargo but due to the on average one-foot increase in the BFE, it is no longer able to be met without considerable cost increases. Since the original floodproof basement wall design was based on this requirement, we have updated the structural design to account for this change. The new structural design can be seen in Appendix G.

  We believe a variance to this requirement is justified since this design either meets or exceeds the original floodproof wall design and it further compliments the required elevations the City has in place that already exceeds the minimums set forth by FEMA.

- *Have the area surrounding the structure on all sides filled to or above the elevation of the base flood. Fill must be compacted with slopes protected by vegetative cover.*

  As can be seen in the previously discussed Floodproof Construction Requirement policy (Appendix B), Fargo has a requirement that fill adjacent to the structure must be at least 0.7-feet above the 41' water surface elevation inundation area (WSEIA). This results in the adjacent ground level at approximately 2.0-feet to 2.5-feet above the base flood elevation (BFE). Within the policy there is

also a requirement that the ground elevation cannot be at or below the BFE level until at least 15-feet away from the structure.

Soil compaction of all fill is met since the City has requirements that all construction within the SFHA must be elevated by fill and follow the LOMR-F requirements, which results in these lots being compacted to a 95% specified density.

- *Have a registered professional engineer or architect develop or review the building's structural design, specifications, and plans, including consideration of the depth, velocity, and duration of flooding and type and permeability of soils at the building site, and certify that the basement design and methods of construction proposed are in accordance with accepted standards of practice for meeting the provisions of this paragraph.*

  Within the Floodproof Construction Requirement Policy (Appendix B) there is a requirement that a Licensed Professional Engineer within the State of North Dakota complete the floodproofing certification form, which certifies that the design meets or exceeds all the applicable requirements. This form must be submitted to the City's Inspections Department with the building permit application.

- *Be inspected by the building inspector or other authorized representative of the community to verify that the structure is built according to its design and those provisions of this section which are verifiable.*

  As previously mentioned, the City's Inspections Department completes seven separate inspections verifying that the construction is meeting the design of the floodproof basement.

4.2 – Solicitation of Views – Cultural Impacts

The City sent out a solicitation of views request to various agencies in regards to the City's desire to continue the basement exception. The purpose of this solicitation was to provide these various agencies an opportunity to comment on any social, economic, and environmental effects on the continuance of the basement exception. In Appendix I, there is a copy of the letter sent out soliciting the views, the mailing list of agencies that received the letter and copies of the responses the received.

APPENDIX A

WATERCOURSE SETBACK

ORDINANCE #4818

OFFICE OF THE CITY ATTORNEY
FARGO, NORTH DAKOTA

ORDINANCE NO. 4818

AN ORDINANCE AMENDING SECTIONS 20-0501, 0502, 0503 AND 0610 AND ENACTING SECTION 20-0508 OF ARTICLES 20-05 AND 20-06 OF CHAPTER 20 OF THE FARGO MUNICIPAL CODE (LAND DEVELOPMENT CODE) REGARDING DIMENSIONAL STANDARDS AND SUBDIVISION DESIGN AND IMPROVEMENTS (RIVER SETBACK PROVISIONS)

WHEREAS, the electorate of the City of Fargo has adopted a home rule charter in accordance with Chapter 40-05.1 of the North Dakota Century Code; and

WHEREAS, Section 40-05.1-06 of the North Dakota Century Code provides that the City shall have the right to implement home rule powers by ordinance; and

WHEREAS, Section 40-05.1-05 of the North Dakota Century Code provides that said home rule charter and any ordinances made pursuant thereto shall supersede state laws in conflict therewith and shall be liberally construed for such purpose; and

WHEREAS, the Board of City Commissioners deems it necessary and appropriate to implement such authority by the adoption of this ordinance;

NOW, THEREFORE,

Be it ordained by the Board of City Commissioners of the City of Fargo:

Section 1. Amendment.

Sections 20-0501, 20-0502 and 20-0503 of Article 20-05 of Chapter 20 of the Fargo Municipal Code (Land Development Code) are hereby amended as follows:

§20-0501 Residential District Standards

The dimensional standards of Table 20-0501 apply to all development in MR-3 and more restrictive zoning districts.

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Table 20-0501

Dimensional Standard	Zoning District										
	AG	**SR-0**	**SR-1**	**SR-2**	**SR-3**	**SR-4**	**SR-5** [9]	**MR-1**	**MR-2**	**MR-3**	**UMU**
Maximum/Minimum Density (UPA - Units per Acre)	0.1 Max.	1.0 Max.	2.9 Max.	5.4 Max.	8.7 Max.	12.1 Max.	14.5 Max.	16.0 Max.	20.0 Max.	24.0 [1] Max.	18.0 Min.
Minimum Lot Size											
Area (Sq. Ft.)	10 Ac	1 Ac [2]	15,000	8,000	5,000	3,600	3,000	5,000	5,000	5,000	2,420
Width (Ft.)	200	120	80	60	50[3]	34[3]	25	50[3]	50[3]	50[3]	50[3]
Minimum Setbacks (Ft.)											
Front	50[4]	50	35	30	20	15[5]	15[5]	25	25	25	10
Interior Side[6]	25	25	15%/15	10%/10	10%/10	4	4	15%/25	15%/25	10	5
Street Side	25[7]	25	17.5	15	12.5	10	10	12.5	12.5	12.5	10
Rear	50	50	25	25	15	15	15	20	20	20	15
Watercourse Setback	[10]	[10]	[10]	[10]	[10]	[10]	[10]	[10]	[10]	[10]	[10]
Max. Building Coverage (Pct. of Lot)	NA	25	25	30	35	45	50	35[8]	35[8]	35[8]	75
Minimum Open Space (Pct. of Lot)	NA	NA	NA	NA	NA	NA	NA	35	35	35	NA
Maximum Height (Ft.)	35	35	35	35	35	35	35	35	45	60	60

[1] Higher densities may be allowed in accordance with the Bonus Density provisions of Sec. 20-0505.

[2] SR-0 minimum district size is 20 acres. See Sec.20-0203-A.

[3] Minimum lot width subject to limitation of access as provided in Sec.20-0702.

[4] Minimum 100 feet from right-of-way on Arterial or section line road.

[5] Minimum 20-foot setback shall be provided between front-entry garages and nearest edge of sidewalk crossing plate.

[6] #/# = Percent of Lot Width/Feet (whichever is less).

[7] Minimum 75 feet from right-of-way on Arterial or section line road.

[8] Maximum of 37.5 percent of building coverage shall be allowed if site amenity is provided in accordance with Sec. 20-0403.B.7. If the amenity is contained within the footprint of one primary structure, the floor area of that amenity is counted as open space, but is not subtracted from the area of the building.

[9] The SR-5 zoning district is limited to a maximum size of 21,000 square feet, but may exceed 21,000 square feet, up to a maximum of two acres provided the district is within 600 feet of a private or public dedicated open space feature, such as a public park, private park, school yard or playground that is accessible to residents of the SR-5 district, any of which shall be a minimum of two acres or more in size. For purposes of identifying a single SR-5 zoning district, parcels adjacent to one another that are, or will be, the same

zoning classification shall be deemed to be within the same zoning district and, therefore, shall be subject to the maximum size limitation.

[10] Watercourse setbacks for all residential, nonresidential and overlay/special zoning districts are as set forth in Section 20-0508.

§20-0502 Nonresidential District Standards

The dimensional standards of Table 20-0502 apply to all development in nonresidential zoning districts.

Table 20-0502

Dimensional Standard	GO	LC	DMU	GC	LI	GI
Minimum Lot Size						
Minimum Setbacks (Ft.)						
Front	20	10	0	20	20	50
Interior Side	5	5	0	5[1]	10[1]	20[1]
Street Side	20	10	0	20	20	50
Rear	15	15	0	15	20	20
Watercourse Setback	[3]	[3]	[3]	[3]	[3]	[3]
Maximum Building Coverage (Pct. of Lot)	65	55	100	85	85	85
Maximum Height (Ft.)	60	35/60 [2]	None	None	None	None

[1] No setback required when adjacent to DMU.

[2] The 35 foot height restriction applies whenever residential protection standards apply, or when the Limited Commercial parcel is within 300 feet of SR zoning. Otherwise, the height limit shall be 60 feet in Limited Commercial zoning districts.

[3] Watercourse setbacks for all residential, nonresidential and overlay/special purpose zoning districts are as set forth in Section 20-0508.

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§20-0503 Overlay/Special Purpose Zoning District Standards

The dimensional standards that apply within overlay and special purpose zoning districts can be found in the following sections:

PUD, Planned Unit Development	Sec. 20-0302[3]
C-O, Conditional Overlay	Sec. 20-0303 (no set standards)[3]
P/I, Public and Institutional	Sec. 20-0304[3]
H-O, Historic Overlay	Sec. 20-0305 (no dimensional standards)[3]
HIA-O, Hector International Airport Overlay	Sec. 20-0306[3]
NO, Neighborhood Office	Sec. 20-0208[3]
NC, Neighborhood Commercial	Sec. 20-0209[3]

Section 2. Enactment.

Section 20-0508 of Article 20-05 of Chapter 20 of the Fargo Municipal Code (Land Development Code) is hereby enacted to read as follows:

§20-0508 Watercourse Setbacks - Restrictions and Exceptions.

A. No building or structure may be erected, constructed, enlarged or altered within the Minimal Disturbance Zone Setback or within the Limited Disturbance Zone Setback unless such building or structure conforms to the regulations in this section.

1. a. **MDZS—Red River and Wild Rice Rivers.** The Minimal Disturbance Zone Setback ("MDZS") for properties near the Red River of the North or the Wild Rice River shall be the greater distance of (a) 350 feet from the center line of the river and (b) the floodway whichever distance creates the greater amount of setback from the center line of the river.

   b. **MDZS—Sheyenne River.** For parcels that are near the Sheyenne River, the Minimal Disturbance Zone Setback ("MDZS") shall be the greater distance of (a) 175 feet from the center line of the river and (b) the floodway whichever distance creates the greater amount of setback from the center line of the river.

2. **LDZS**. The Limited Disturbance Zone Setback ("LDZS") shall begin at the outer edge of the Minimal Disturbance Zone Setback and extend an additional one hundred (100) feet on the same line as for the MDZS.

For purposes of determining of the disturbance zone setbacks, distances shall be measured horizontally and perpendicular from the tangent of the center line of the applicable water course. For purposes of this ordinance, "floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a stated amount, as the same has been formally adopted either by the board of city commissioners, by the Federal Emergency Management Agency (FEMA) on a Flood Insurance Rate Map (FIRM), or by both the board of city commissioners and FEMA. To the extent the board of city commissioners and FEMA have adopted different floodways, the floodway most recently adopted shall be deemed to be the floodway for purposes of this ordinance.

B. **Disturbing Land Prohibited.** No person, firm, corporation or other entity shall engage in any man-made change to improved or unimproved real estate, including but not limited to, buildings or other structures, mining, dredging, filling, grading, paving excavation or drilling operations within the MDZS or the LDZS unless such development conforms to the regulations in this section. Such man-made changes shall include, without limitation, any development as the same is described in Fargo Municipal Code Article 21-06.

C. **Minimal Disturbance Zone Setback.** All property within the MDZS calculated in accordance with this section shall conform to the following regulations:

1. No permanent structures shall be allowed except the following:

(a) Stairways, Lifts and Landings - Stairways and lifts are the preferred alternative to major topographic alterations for achieving access up and down steep slopes to watercourses. Stairways and lifts must meet the following design requirements:

(i) Stairways and lifts shall not exceed four (4) feet in width on residential lots and eight (8) feet in width for commercial properties or public open-space recreational properties. Residential lots are permitted one stairway or lift and one facility to provide watercourse access for the physically challenged. The number of

accesses for commercial or public open-space shall be determined on a case-by-case basis by the board of city commissioners.

(ii) Landings for stairways and lifts on residential lots shall not exceed thirty-six (36) square feet in area. Landings no larger than sixty-four (64) square feet shall be used for commercial properties, public open-space recreational properties.

(iii) Canopies or roofs shall not be allowed on stairways, lifts, or landings.

(iv) Where reasonably possible, stairways, lifts and landings shall be constructed above the ground on posts or pilings. Stairways, lifts and landing may be placed into the ground, provided they are designed and built in a manner that ensures control of soil erosion.

(v) Facilities such as ramps, lifts or mobility paths for the physically challenged to achieve watercourse access shall not exceed four (4) feet in width for residential lots and eight (8) feet in width for commercial properties or public open-space recreational properties.

(vi) Stairways, lifts and landings shall not prevent or limit the use of public paths or public or private non-motorized vehicle lanes or any other easements.

(b) Roads, bridges, trails, storm drainage, stormwater management facilities and utilities are permitted within the minimal disturbance zone provided that an alternatives analysis has clearly demonstrated that no other feasible alternative exists and that minimal disturbance will take place. These structures shall be located, designed, constructed and maintained to provide maximum erosion protection, to have the least adverse effects on wildlife, aquatic life and their habitats and to maintain hydrologic processes and water quality. Following any disturbance, the impacted area shall be restored.

(c) Bike paths, walking trails, or other multi-use paths.

(d) A public rest room or a public facility that is open on all sides and

functionally related to a designated open space or recreational use.

2. No additional fill shall be allowed.

3. No grading shall be allowed, except grading for bank restoration in areas experiencing bank slumping.

4. No excavating shall be allowed.

5. On-site septic systems and drain fields shall not be permitted.

6. Irrigation systems shall not be permitted.

7. Notwithstanding the foregoing restrictions or prohibitions, permanent flood protection levees or walls may be constructed within the MDZS or LDZS provided the soil is determined, in the opinion of the city engineer, to be sufficiently stable to support the proposed flood protection structure without slumping or shifting.

D. **Limited Disturbance Zone Setback.** With respect to all property within the LDZS calculated in accordance with this section, the regulations with respect to the said 100-foot setback of the LDZS shall be the same as the regulations for the MDZS (Subsection C), except as follows:

1. In the Limited Disturbance Zone Setback, one accessory building not to exceed One Hundred Twenty (120) square feet shall be allowed.

E. **Transitional Provisions to Watercourse Setback Restrictions.** To the extent that land within either the MDZS or LDZS was platted prior to the effective date of this ordinance, the following additional regulations shall apply:

1. Exemptions--existing parks and golf courses; lots across street from river. Golf courses that exist as of the effective date of this ordinance and park land of the city or of the Park District of the City of Fargo shall be exempt from the provisions of this ordinance except with respect to permits that would otherwise be required by law other than this ordinance and that are related to buildings or structures within the MDZS or the LDZS. With respect to parcels that have been platted prior to the effective date of this ordinance that are

within the MDZS or LDZS, to the extent that a permanent flood protection structure is able to be constructed on the side of the street nearest the river to the elevation established by city policy by motion, resolution or ordinance of the board of city commissioners said parcels shall be exempt from the provisions of this section and building permits may be issued for said parcels.

2. Previously Platted Lands (and not built upon).

Building permits may not be issued for new buildings or structures within either the MDZS or LDZS for parcels that have been platted prior to the effective date of this ordinance and have not been previously built upon unless a waiver is obtained from the board of city commissioners. A parcel shall be considered built upon if a valid building permit has been issued prior to the effective date of this ordinance or if a bona fide application for a building permit has been received by the Building Official prior to the effective date of this ordinance. An applicant shall only be eligible to receive such a waiver if the requested building permit is for a proposed building or structure that will be located no nearer than 100 feet from the nearest floodway. In reviewing an application for a waiver of this prohibition, the board of city commission shall consider the following factors:

(a) The extent to which the subject property is already protected from the risk of flooding.
(b) The extent to which the soil is sufficiently stable to support the proposed building or structure without slumping or shifting of soil.
(c) The extent to which the proposed building or structure may be elevated to such a level as to mitigate against the risk of flooding.
(d) The adequacy of area available to install emergency flood protection if the proposed building or structure were in place.
(e) If the proposed building or structure is accessory to a principal building or structure, the extent to which the accessory building or structure to either be constructed to an elevation to appropriately minimize risks of flooding or, in the alternative, or be designed and constructed so as to tolerate being flooded.

3. Previously Platted Lands (and built upon). With respect to applications in which a permit is requested related to a parcel within either the MDZS or LDZS that has been platted prior to the effective date of this ordinance but has already been built upon, such building permit may be issued for a building or structure as follows:

(a) Enlargement or alteration of existing principal buildings or structures shall be allowed so long as the proposed enlargement or alteration does not extend the building or structure closer to the river; and,

(b) Interior remodeling of an existing building or structure is allowed.

(c) To the extent said parcel contains one or more principal buildings or structures lying, in whole or in part, within the MDZS, the LDZS, or both, and in the event any of such buildings or structures is damaged or destroyed by any means, to the extent of more than 50 percent of its structural value prior to the damage, that building or structure may be restored, repaired or rebuilt in its entirety in accordance with the provisions in the Land Development Code regarding non-conforming structures (See generally LDC §20-1004).

F. **Conflict with Other Regulations.**

1. Where the standards and management requirements of this setback are in conflict with other laws, regulations, ordinances or policies regarding streams, steep slopes, erodible soils, wetlands, floodplains, timber harvesting, land disturbance activities or other environmental protective measures, the more restrictive requirements shall apply.

2. Nothing herein shall be interpreted to abrogate or limit the applicability of any other local, state or federal law, including without limitation the floodplain management regulations of the Federal Emergency Management Agency of the United States of America.

3. Nothing herein shall be interpreted to abrogate or limit the applicability of any substantial improvement provisions of the floodplain management regulations as identified in article 21-06 of the Fargo Municipal Code, as the same may be amended from time to time.

Section 3. Amendment.

Section 20-0610 of Article 20-06 of Chapter 20 of the Fargo Municipal Code (Land Development Code) is hereby amended to read as follows:

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§20-0610 River Easements and Watercourse Setbacks

A. Maintenance easements shall be established on all land within 40 feet of the Mean High Water Line of all rivers and legal drains. Improvements shall be allowed within such maintenance easements, provided that the City shall be granted authority to temporarily occupy such easements when necessary to conduct maintenance work on the adjacent river or drain.

B. All Final Plats prepared for recording shall:

1. Show the extent of any minimal or limited disturbance zone setbacks on the subject property by metes and bounds and be labeled as "Minimal Disturbance Zone Setback" or "Limited Disturbance Zone Setback"

2. Provide a note to reference the minimal or limited disturbance zone setbacks stating, "There shall be no clearing, grading, construction or disturbance of soil and/or native vegetation except as permitted by the ordinances of the city of Fargo"

3. Provide a note to reference any protective covenants governing all minimal or limited disturbance zone setbacks, "Any minimum or limited disturbance zone setbacks shown hereon are subject to protective covenants which may be recorded in the Office of the Recorder for Cass County and which restrict disturbance and use of these areas."

C. All minimal or limited disturbance zone setbacks must be protected during development activities. Prior to the initiation of development activities, the minimal and limited disturbance zone setbacks shall be surveyed and iron pins set in the ground on side lot lines and adequate visibility of the minimal or limited disturbance zone setbacks shall be provided by staking and flagging.

D. Minimal or limited disturbance zone setbacks shall be established and maintained through a declaration of protective or restrictive covenant, which must be submitted for approval by the board of city commissioners. The covenant shall be recorded in the Office of the Recorder for Cass County and shall run with the land and continue in perpetuity and may not be amended or terminated without approval of the city.

E. All lease agreements pertaining to parcels with MDZS areas, LDZS areas, or both

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areas, must contain a notation regarding the presence and location of protective covenants for minimal or limited disturbance zone setbacks, and must contain information on the management and maintenance requirements for the minimal or limited disturbance zone setbacks for the tenant.

F. No subdivision may be approved without a notation and delineation of an area One Hundred Seventy-Five (175) feet from the centerline of any legal drain and the applicant for subdivision approval will be required to dedicate such areas to the public for purposes of such drain.

Section 4. Penalty.

A person who willfully violates this ordinance is guilty of an infraction. Every person, firm or corporation violating an ordinance which is punishable as an infraction shall be punished by a fine not to exceed $500.00; the court to have power to suspend said sentence and to revoke the suspension thereof.

Section. 5. Effective Date.

This ordinance shall be in full force and effect from and after its passage, approval and publication.

Dennis R. Walaker, Mayor

(SEAL)

Attest:

Steven Sprague, City Auditor

First Reading: 04-16-2012
Second Reading: 04-30-2012
Final Passage: 04-30-2012
Publication: 05-14-2012

APPENDIX B

CITY OF FARGO FLOODPROOF CONSTRUCTION REQUIREMENTS

Floodproof Construction Requirements

CITY OF FARGO BUILDING
INSPECTION DIVISION
Updated December 2014

The State of North Dakota requires that you call *1-800-795-0555* at least two business days before you dig.

This handout does not address any covenants or easements assigned to the property, nor does it relieve you of code compliance with items which may not have been included from the International Codes.

REQUIREMENTS TO OBTAIN A BUILDING PERMIT FOR FLOODPROOF CONSTRUCTION

CITY OF Fargo

Draft

ALL PLANS MUST BE DRAWN TO SCALE

1. Floodproofing Certification Form from a State of North Dakota registered professional engineer. Required before Permit issuance.
2. Plot plan showing existing elevations of property.
3. Plot plan showing exact location of new building or addition and existing buildings.
4. Floor plan(s) of new building(s).
5. Elevation views of all sides of building. Elevation plans must show grade.
6. Foundation wall sections showing required construction details per City flood proof specifications. (See enclosed details.)
7. Foundation plans showing drain tile location and footings.

THE FOLLOWING ITEMS ARE INCLUDED IN THIS PACKET

A. Typical Floodproofing Construction Requirements Exhibits

B. Foundation and basement wall structural details from *Floodproof Basement Structural Requirements Report*, created by KLJ, dated November XX, 2014.

C. Inspection log for foundation. Inspections will be completed by Inspection Department.

D. FEMA Residential Floodproofing Certificate.

A CERTIFICATE OF OCCUPANCY WILL BE REQUIRED BEFORE BUILDING OCCUPANCY

Draft

CITY OF FARGO POLICY STATEMENT FOR FLOODPROOFING ELEVATION REQUIREMENTS

Referenced to the following:

Fargo Municipal Code Article 21-06 (Flood Plain Management)
Floodproofing Code of the City of Fargo, North Dakota, prepared by Moore Engineering, Inc., Revised December 9, 1975

Applicable to the following:

This Policy Statement shall regulate development within City of Fargo City Limits and Extra Territorial Areas. The specific areas governed, by this policy are the FEMA 1% annual chance floodplain and the 41-foot water surface elevation inundation area.

I. All Structures

All structures, including but not limited to, residential, commercial, and industrial construction within the city limits and extra territorial areas shall meet the following requirements:

A. Floodway Setback
All structures must be set back 100' from floodway line

B. Watercourse Setbacks
All provisions of the Minimum and Limited Disturbance Setbacks zones as identified under City Municipal Code §20-0508 shall be met.

C. Primary Flood Protection Line
1. All properties adjacent to a river, drainage ditch or other flooding source, as determined by the City Engineer, must include a primary flood protection line.
2. Primary flood protection line elevation shall be FEMA Base Flood Elevation (BFE) plus 4.0'.
3. Primary flood protection line must be constructed throughout a proposed development (not on a lot by lot baisis) prior to issuance of any building permits.
   a. Plats approved by City Commission prior to March 4, 2014 may have a primary flood protection line constructed on a lot by lot basis. Protection line must be completed at the time of issuance of occupancy certificate.
4. Primary flood protection line shall be constructed according to the City of Fargo Standard Specifications, Section 3600.

D. Letter of Map Revisions (LOMR)
The City of Fargo encourages construction outside of the FEMA Special Flood Hazard Area (SFHA) and requires removal from the SFHA by Letter of Map Revision (LOMR) via fill or ring dike.
1. All fill placement shall follow the current City of Fargo Standard Specifications, Section 3600.
2. No more than five feet (5') of fill may be placed for buildings in areas removed from FEMA SFHA by LOMR
   a. Fill in excess of five feet may be permitted, provided the fill is Engineered fill designed by a State of North Dakota registered professional engineer and the design plan is provided to the City in advance of construction.
3. All structures constructed within LOMR areas must meet all floodproofing codes.

E. Infrastructure Elevations
   1. All streets are to be constructed to a minimum of FEMA BFE minus 0.5' at the low point (Back of Curb to be at FEMA BFE)
   2. All sanitary sewer facilities, including private sewer connection manholes, cleanouts, etc. must be protected to an elevation equal to the FEMA BFE. Protection measures include sealing and/or elevating.
   3. Storm sewer system shall be protected by infrastructure designed to be at or above an elevation of FEMA BFE plus 5.0'

F. Certifications
   1. Elevation Certificates are required for all flood proofed structures.
   2. Elevation Certificates for existing non flood proofed structures may be required if the structure is located in the FEMA SFHA.
   3. Pre- Construction Floodproof Certification Form from FEMA is required for floodproof foundations, and must be provided to the City at the time the Building Permit is requested.

II. Single Family and Multi-Family Residential Structures Within 41-foot Water Surface Elevation Inundation Area (WSEIA) (See Exhibit A)

All construction within the 41-foot WSEIA as determined by the City Engineer shall meet all floodproofing codes, in addition to the following elevation and fill requirements:

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'
Fill around building	Equal to 41-foot WSEIA plus 0.7'
Fill 15' away from buildings	At or above FEMA BFE

B. All underground parking must meet floodproofing codes, including the above specified elevation and fill requirements.

III. Single Family and Multi Family Residential Structures Outside the 41- foot WSEIA

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'
Fill around building	Equal to 41-foot WSEIA plus 0.7'

B. Foundations — No special requirements

IV. All Structures (Excluding Residential) Within the FEMA 1% Annual Chance Floodplain (See Exhibit A)

All construction within the FEMA 1% annual chance floodplain as determined by the City Engineer shall meet all floodproofing codes, in addition to the following elevation and fill requirements:

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'

(highest elevation of two shall be required)	Or Equal to FEMA BFE plus 2.0'
Fill around building	Equal to 41-foot WSEIA plus 0.7'
Fill 15' away from buildings	At or above FEMA BFE

B. All underground parking must meet floodproofing codes including specified elevation and fill requirements.

C. Structures within a contemplated LOMR area with a proposed depressed loading dock will be allowed to have the loading dock area below the specified adjacent ground elevations if the building is a slab on grade with the lowest finished floor elevation of the structure at the WSEIA plus 1.2'.

V. All Structures (Excluding Residential) Outside of the FEMA 1% annual chance floodplain (See Exhibit B)

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'
Fill around building	Equal to 41-foot WSEIA plus 0.7'

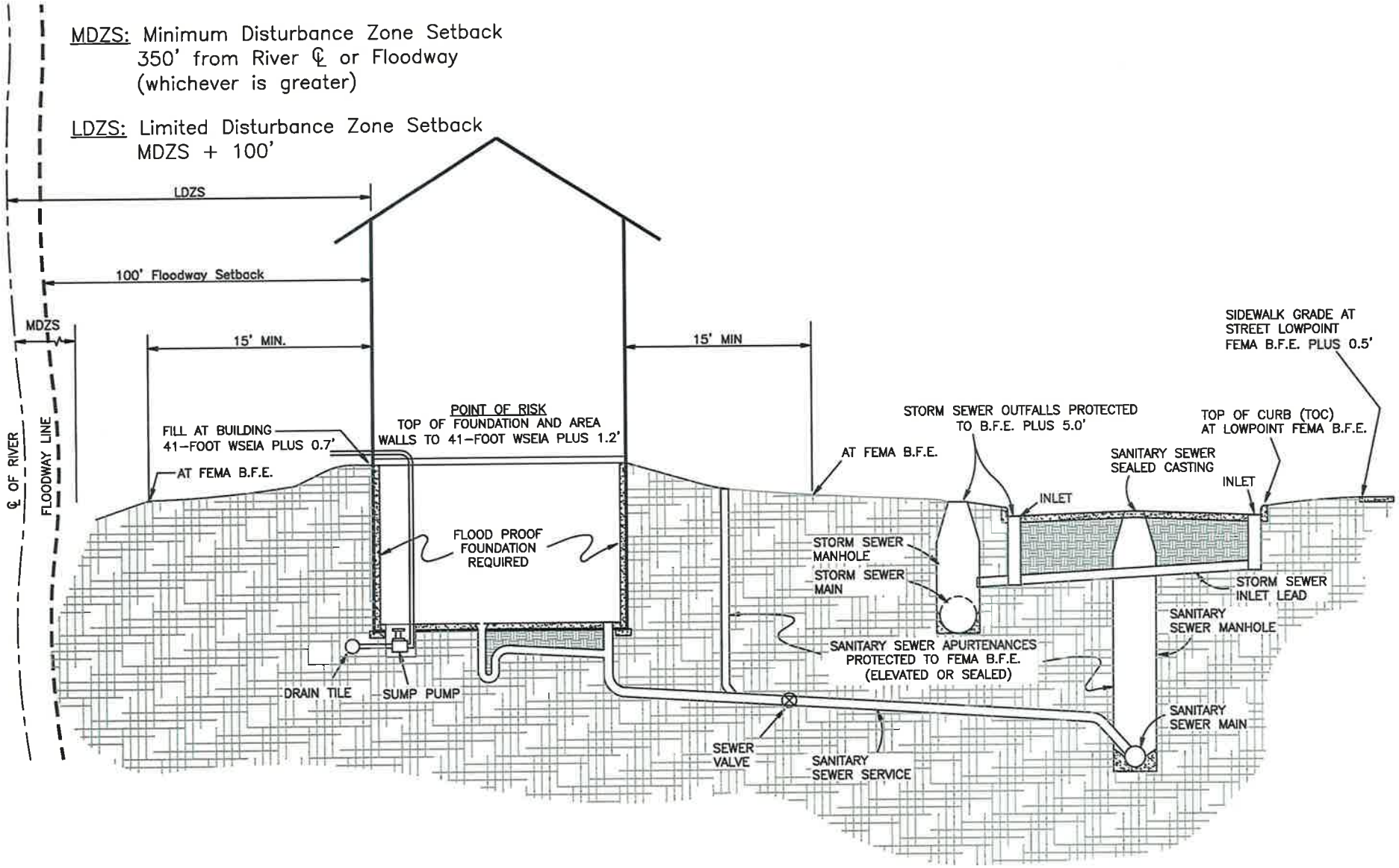
B. Foundations

Setback dimensions are determined by the FEMA 1% annual chance floodplain polygon edges.

1. If building within 25-feet of the FEMA 1% chance floodplain, all construction must conform to all floodproof codes.
2. If building within 50-feet of the FEMA 1% chance floodplain, standard concrete foundations are required, floodproof construction is recommended.
3. If building is more than 50-feet from the FEMA 1% chance floodplain, there are no special requirements although floodproof construction is recommended.

APPENDIX A

TYPICAL FLOODPROOFING CONSTRUCTION REQUIREMENTS EXHIBITS



Single Family & Multi Family Residential Structures
within the 41.1 foot Water Surface Elevation Inundation Area

Non Residential Structures
within the FEMA 1% Annual Chance Floodplain

CITY OF Fargo
Engineering Dept.

Scale: NTS

Flood Proofing Construction Requirements Exhibit "A"

2/26/2014
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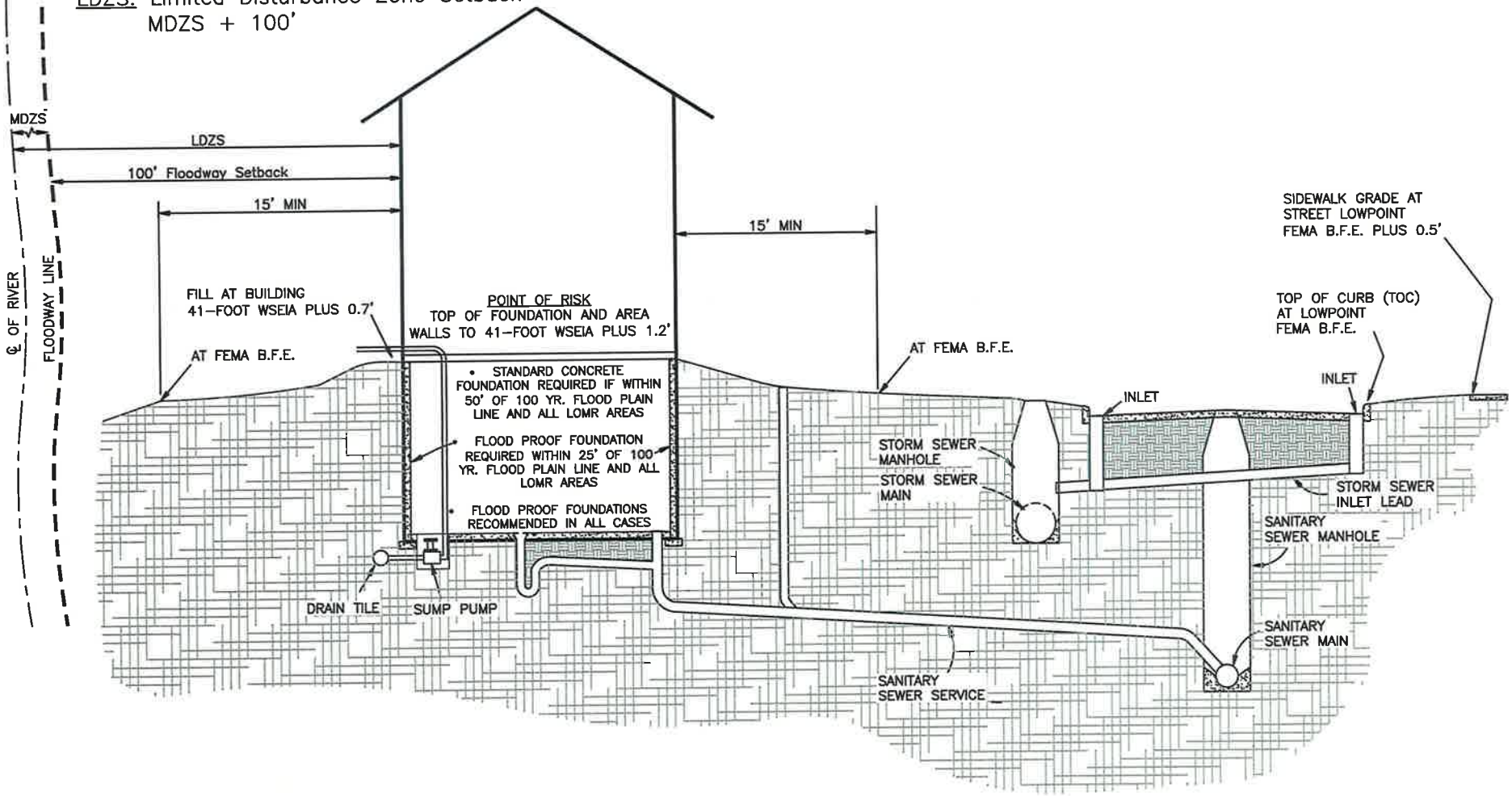
MDZS: Minimum Disturbance Zone Setback
350' from River ℄ or Floodway
(whichever is greater)

LDZS: Limited Disturbance Zone Setback
MDZS + 100'



Non Residential Structures
within 50' of the FEMA 1% Annual Chance Floodplain

Engineering Dept.

Scale: NTS

Flood Proofing Construction Requirements Exhibit "B"

2/26/2014
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APPENDIX B

FLOODPROOF BASEMENT STRUCTURAL REQUIREMENTS REPORT

Prepared for:

City of Fargo
Engineering
Department
200 3rd Street North
Fargo, ND 58102

Prepared by:

KLJ
728 East Beaton
Drive, Suite 101
West Fargo, ND

November 20, 2014

Structural Design Requirements

Floodproofed Basements in Fargo, ND

KLJ

Structural Design Requirements

Floodproofed Basements in Fargo, ND

Prepared for:

City of Fargo
Engineering Department
200 3rd Street North
Fargo, ND 58102

Prepared by:

KLJ
728 East Beaton Drive, Suite 101
West Fargo, ND

November 20, 2014

TABLE OF CONTENTS

I. Executive Summary

KLJ and Braun Intertec, Corp. were asked to review the structural requirements of the City of Fargo's existing Floodproofing Code as they relate to current industry practices and design codes. The existing code has performed well under flooding conditions since its inception and has been tested multiple times including major floods of 1997 and 2009. However, the structural requirements have changed very little since it was first created in 1975. The recommendations included herein are based on industry standards and current building code requirements.

II. Analysis

Upon review of documents used to develop previous floodproofing codes, it was determined more information should be gathered related to the soils in the Fargo area and how they affect the structural design requirements for floodproofing basements. Braun Intertec, Corp prepared a geotechnical evaluation for this report which included a seepage analysis and recommendations for lateral earth pressures. Conclusions drawn from the geotechnical evaluation where used to develop the structural design requirements included herein.

A. Seepage Analysis

Braun Intertec, Corp. was asked to perform a seepage analysis on the soils in the Fargo, North Dakota area. The results of their findings are included in Appendix A of this report. A summary of Braun's findings are as follows:

1) Based on discussions with the Fargo-Moorhead Home Builder's Association, foundations on most lots are currently being built on fairly shallow excavations. For the Fargo area, the soils at this depth are a part of the Sherack formation. The fill material brought in to build up the sites is also typically from this formation.

2) The soils in the Sherack formation are typically impervious, but some silt lenses are known to exist. The silt lenses can be troublesome as water can travel through them.

3) Laboratory testing was performed to determine the hydraulic conductivity of the soils in the Fargo area. Hydraulic conductivity is a measurement used to describe the flow of water through the soil. The tests indicate the soils in the Sherack formation have a hydraulic conductivity of 1E-4 foot per day vertically. Observation of local construction projects indicates the horizontal conductivity of 1E-3 foot per day. These numbers indicate is the soils in the Fargo area are impermeable and water does not travel well through the Sherack. It should be noted, however, these values reflect well compacted material, and realistic values for backfill against homes would be "1 to 2 orders of magnitude faster."

4) Groundwater elevations vary throughout the year between five to ten feet below grade. Interviews with local homeowners indicated that bi-level basements (four feet below grade) had sump pumps that ran only during wet seasons and full depth basement sump pumps ran year round.

5) A seepage analysis concluded that basements with a 15 foot setback to the BFE (base flood elevation) would not infiltrate a house foundation for several months for a basement that is nine feet below grade. It was noted that if flood waters were allowed to reach the home during the peak flood the soil could become saturated causing hydrostatic pressures to be of concern. A peak flood was assumed to last "several days to 2 weeks before receding."

B. Lateral Earth Pressures

Braun recommends using an active equivalent fluid pressure of 65 pounds per cubic foot (PCF) per foot depth for soils in the Sherack formation to design basement walls. In order for this assumption to be accurate, the following criteria must be met:

1) Basements should have a flexible diaphragm and adequate subsurface drainage for this assumption to be accurate.

2) A wood floor and subfloor above the basement is considered a flexible diaphragm.

3) Adequate surface drainage must be provided around the perimeter of the home. If silt lenses or sand are found in excavations, the excavations should be over-excavated by at least ten feet horizontally from the basement walls and backfilled with fat clay soils, similar to that of the Sherack formation.

4) If flood water comes in contact with the house or backfill or if the drain tile/sump pump fails, considerations should be made to flood the basement to minimize structural damage due to hydrostatic pressures.

C. Structural Design Requirements

KLJ performed an analysis on basement wall construction for full depth basements and bi-level basements in Fargo based on the design parameters provided by Braun Intertec and design requirements detailed in the U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314*. A summary of the analysis is included in the following sections.

DESIGN CODES:

Analysis of basement wall construction shall comply with the following building codes:

1) 2012 International Building Code (2012 IBC)

2) 2012 International Residential Code (2012 IRC)

3) American Concrete Institute 318-11: Building Code and Commentary (ACI 318-11)

4) 2012 National Design Specification (2012 NDS) for Wood Construction

STRUCTURAL LOADS:

1) Hydrostatic loads on the structure need not be considered with a 15 foot setback to the BFE. Under these conditions, Braun's seepage analysis determined it would take several months to saturate the soil adjacent to the basement walls. Given that peak floods only last about two weeks and homes are being constructed with a subsurface drainage system, the probability is very low that flood waters would reach foundation walls.

2) Hydrodynamic loads on the structure do not need to be considered. As per the *Flood Insurance Study* booklet prepared by FEMA for Cass County, North Dakota (effective January 16, 2015), the mean velocity of the Red River varies between 0.8 and 2.5 feet per second. The U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* states hydrodynamic loads need only be considered with velocities of five feet per second or greater.

3) Impact loads do not need to be considered as the probability that flood water elevations would exceed the ground elevation adjacent to the structure would be minimal.

4) Buoyancy is not a concern with flood and groundwater levels being maintained below the basement slab with a subsurface drainage system.

5) Basement walls and their connections shall be designed using an active equivalent lateral earth pressure of 65 PCF.

ANALYSIS:

KLJ completed a structural analysis on full height, bi-level, and window well basement walls using the design codes and loads listed above. Tables and figures associated with the analysis are provided in Appendix B. A summary of the design procedure used to develop each table and figure is as follows:

1) Full height basement walls:

   a) Two reinforcing options are provided in Tables 1A and 1B.

      i) Case A includes provisions for 2-way slab action in the concrete walls to minimize the connection requirements at the top of the wall.

      ii) Case B also accounts for 2-way action in the concrete walls and allows for maximum spacing between walls perpendicular (i.e. jogs) to the foundation wall. Minimum reinforcing is based on the worst case between temperature and shrinkage steel or steel required to achieve moment capacity.

      iii) A detail of the reinforcing requirements is provided in Figure 1.

2) Bi-level basement design was based on a cantilevered concrete foundation wall. Reinforcing requirements are provided in Table 2 and a detail of the wall construction is provided in Figure 2.

3) Window well walls were designed to span horizontally. Reinforcing requirements are included in Table 3. A detail of the wall construction is provided in Figure 3.

D. Waterproofing

Waterproofing is required on the exterior surface of all basement walls and below basement slabs. Waterproofing shall be continuous from the top of the soil to the bottom of the footing. Recommendations for waterproofing materials are provided below.

1) Foundation wall: Fluid-applied or sheet-applied waterproofing methods may be utilized. The exterior surface of the foundation wall, top of footing and side of footing. Foundation waterproofing shall consist of a fluid-applied waterproofing membrane, with a minimum thickness of 60 wet mils of "CCW-703 Liquiseal" or a sheet applied waterproofing membrane, self-adhering for vertical and horizontal applications

of either "MiraDRI 860" for warm temperature installations or "MiraDRI 861" for colder temperature applications. Similar products may be used as an approved equal.

2) Under slab: Under slab waterproofing shall consist of a 55 mil, horizontal grade "MiraPLY-H" membrane. "Liquiseal", "MiraDRI", and "MiraPLY-H" waterproof membrane products are manufactured by Carlisle Coatings & Waterproofing of Wylie, Texas. Similar products may be used as an approved equal.

III. Conclusions

An active equivalent lateral earth pressure of 65 PCF shall be used as the basis of design for floodproofing basement structures. Tables and figures are provided in Appendix B to assist with construction of the wall construction types presented herein. The following conditions must be met to comply with the design recommendations included in this report.

1) Basement shall be constructed as per Exhibit A in the City of Fargo's *Floodproof Construction Requirements*.

2) Drain tile or other approved subsurface drainage be provided around interior and exterior basement perimeter and tied into an appropriately sized sump pit with a functioning sump pump.

3) The basement shall be waterproofed with the products included in this report (or approved equivalents).

4) In the event overtopping is eminent or the sump pump fails and is not able to be reinstated in a timely manner, it is recommended the basements be filled with clean water to minimize structural damage as a result of hydrostatic pressure and uplift.

Appendix A

Geotechnical Reports

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
526 10th Street NE, Suite 300
P.O. Box 485
West Fargo, ND 58078

Phone: 701.232.8701
Fax: 701.232.7817
Web: braunintertec.com

November 6, 2014

Project B14-07345

Cassie McNames, PE
KLJ, Inc.
728 East Beaton Drive, Suite 101
West Fargo, North Dakota 58078

Re: DRAFT Geotechnical Evaluation Letter
City of Fargo Project #MS-14-71
Floodproof Basement Structural Review
Fargo, North Dakota

Dear Ms. McNames:

This Geotechnical Evaluation Letter addresses geotechnical aspects of the City of Fargo's Floodproof Basement Structural Review.

Background

We understand the original design of the City of Fargo's floodproof basement was completed in 1975 and at that time the City was able to receive a basement exception from FEMA. As part of the current FEMA floodplain remapping process, the City is required to renew their basement exception with FEMA. As part of this renewal we understand KLJ is assisting the City with a structural analysis of the standard basement wall detail. The City requested that you engage a geotechnical engineer to provide recommendations for soil parameters to be used in design of the wall as well as a seepage analysis to estimate the timeframe for full saturation of soil adjacent a basement wall.

Information Reviewed

In preparation of this letter, we reviewed a number of documents and resources. These documents and resources are listed below along with some of the key takeaways we considered from each.

- August 27, 1974 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Soil Pressures in the Fargo-Moorhead Area.
  - Design walls to withstand an equivalent fluid pressure of 120 pcf.
  - Install a drain tile system at the perimeter and below the floor to control uplift.
  - Backfill utility connection trenches with well compacted clayey soil to prevent easy flow nets for infiltrating water.
  - All sites should be checked by a knowledgeable individual to determine that there is not an unusual uniform silt condition present or pervious fill.
- February 24, 1975 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Basement Soil Pressures in the Fargo-Moorhead Area.
  - Ulteig and SEC discussed several homes that were completely surrounded by floodwater for 2 weeks (although overland flow did not reach the basement walls). The homes were

not designed for a maximum soil pressure [120 pcf] and the basement walls were not affected by horizontal soil pressure.
    - A design of less than the maximum soil pressure should provide for construction detail that will insure the maximum stress will not occur.
    - A lesser design soil pressure value was not stated, but it was stated that a "solution within reasonable economic means can be obtained" if freestanding water will not be adjacent the walls, surrounding soils are cohesive and relatively impervious, a drain tile system is in place to collect seepage, easy flow channels to the structure be prevented, utility trenches should be backfilled with cohesive soils and well compacted, gravel fill under driveways and so forth should be kept above flood levels, adequate surface drainage must be maintained away from the structure, and down spouts and local runoff cannot allow ponding adjacent walls.
    - The homeowner should be informed that his basement is not designed to withstand full hydrostatic pressure and he should understand the necessity of maintaining the drain tile system and that if the system fails or if flood waters make approximate contact with the basement walls, the basement should be flooded.
- City of Fargo Code of Ordinances, Article 21-0102, Section 1610.1
    - Exception to International Building Code: Foundation walls extending not more than 9 feet below grade and laterally supported at the top by flexible diaphragms shall be permitted to be designed for active pressure.
- Home Builders Association meeting on October 15, 2014
    - Currently on LOMR lots, excavations to bottom of foundation level are typically about 1 to 3 feet below natural ground and the remainder of the pad is built up from there.

Discussion

Soils

The soils in the City of Fargo were deposited by Glacial Lake Agassiz and are rather consistent across the City. The soils within the typical basement depth of not more than 9 feet consist of what is known as the Sherack formation. As they exist in the upper 9 feet, materials from this formation are most often used as basement wall backfill and from our experience they are also most often used as fill on LOMR lots.

The Sherack formation consists of fat clay that is rather impervious, but is sometimes stratified with silt or sand seams and layers that will increase its hydraulic conductivity. The Sherack formation most often weighs about 115 pcf in its normal, wet condition. Numerous shear strength tests we have performed on material from the Sherack formation indicate that if well compacted it will have a typical internal friction angle of about 25 degrees. Since house pad excavations are relatively small in size, they limit the size of compaction equipment and the overall effectiveness of compaction effort. To account for this we have assumed the internal friction angle for wall design of about 2/3 this value, or 16 degrees. This assumption should not relieve the contractor from the need for compaction of the backfill.

The conductivity of the Sherack formation averages approximately 1E-4 ft/day vertically (as determined from our laboratory testing) and 1E-3 ft/day horizontally (as determined through the in-situ monitoring of pore water pressure dissipation on local embankment construction projects). The conductivity of backfill is highly variable and dependent on material type, placement and level of compaction. Well

compacted backfill would likely have conductivity values similar to those stated for the Sherack formation, while poorly compacted backfill is likely 1 to 2 orders of magnitude faster.

Groundwater

Measured groundwater depths typically vary across the City with location and season, but we have found that most often groundwater is encountered within about 5 to 10 feet of the ground surface seasonally. With regards to sump pump operation, we interviewed 12 homeowners across the City with variability in location, age of home, and depth of basement. The responses were very consistent in that homeowners with split level structures, or 4-foot deep basements, had sump pumps that ran only during rainy periods and homeowners with full basements had sump pumps that ran outside of rainy periods and several stated year round. These interview results would support the groundwater measurements we have observed within 5 to 10 feet of the ground surface.

Analysis

We performed a seepage analysis using a finite element program called SEEP/W from GeoStudio. The analysis was performed for a home with soil conditions typical of the Fargo area. We assumed that the basement is 9 feet below the ground surface and that flood waters would not be closer than 15 feet from the basement wall. The 15-foot distance was selected as it is typically greater than the excavation width for a basement wall and it is also currently the requirement by the City of Fargo for the minimum distance from the BFE for flood proofing construction.

The analysis indicates that the flood waters would have to be in place for several months for water to infiltrate to the house foundation or even the normal backfill wedge against a house. Peak flood conditions in this area typically last several days to as much as about 2 weeks before receding. It should be noted that if flood water contacted a basement wall and covered the wall backfill, saturation of the backfill could occur within the normal timeframe of peak flood conditions.

Recommendations

For design of basement walls we recommend using an active equivalent fluid pressure of 65 pcf per foot of depth (this value does not include a factor of safety). This value assumes the soil conditions noted in the *Discussion* above, and that the wall has a flexible diaphragm, and also assumes that the house has a functioning drain tile system. Many basements are constructed above the groundwater, but even those that are below the groundwater (estimated at 1 to 2 feet maximum seasonally) can experience drawdown of the groundwater below the active pressure zone on the wall if a properly functioning drain tile system is in place.

To use this value we further recommend that grades within 10 feet horizontal of the perimeter of the house should be sloped down and away from the structure at a minimum gradient of 5 percent to prevent ponding, and all roof run-off should be collected by gutters and routed to drains with long downspouts, which are diverted to areas more than 5 to 10 feet from the structure.

If basement excavations encounter layers of sand or silt, the excavations should be constructed so that they extend at least 10 feet away from the basement walls, and the entire excavation should be

backfilled with fat clay soils typical of the area to lessen seepage through the sand/silt layer towards the structure.

As noted by Soil Engineering Company, we agree that if flood water comes in contact with the house or wall backfill, or if the drain tile system fails during periods of flooding, the homeowner should consider flooding the basement to limit structural damage to the basement wall.

Remarks

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions about this Letter, please contact Nate McKinney or Sean Swartz at 701.232.8701.

Sincerely,

BRAUN INTERTEC CORPORATION

Sean S. Swartz, PE
Principal Engineer

Professional Certification:
I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of North Dakota.

Nathan L. McKinney, PE
Principal – Senior Engineer
Registration Number: PE-6735
November 6, 2014

Appendix B

Tables and Figures

Table 1A: Minimum Reinforcement Requirements for Floodproofed Basement Walls - Full Height Walls (65 PCF)

Wall Height (ft)	Case	Wall Thickness (in)	Vertical Reinforcing	Horizontal Reinforcing	Maximum Horizontal Distance between Perpendicular Foundation Walls (ft)	Dowel Spacing (ft)
7.5	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 40 " o.c.	7.5	4'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 22 " o.c. # 5 @ 30 " o.c. # 6 @ 44 " o.c.	# 4 @ 24 " o.c.	15	1'-10" o.c.
		10	# 4 @ 24 " o.c. # 5 @ 36 " o.c. # 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			
8	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 40 " o.c.	8	2'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 18 " o.c. # 5 @ 26 " o.c. # 6 @ 40 " o.c.	# 4 @ 24 " o.c.	16	1'-6" o.c.
		10	# 4 @ 24 " o.c. # 5 @ 36 " o.c. # 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			
9	A	8	# 4 @ 24 " o.c.	# 4 @ 14 " o.c. # 5 @ 22 " o.c. # 6 @ 28 " o.c.	9	2'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 26 " o.c.	# 4 @ 24 " o.c.	18	1'-0" o.c.
		10	# 4 @ 16 " o.c. # 5 @ 24 " o.c. # 6 @ 36 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the inside face of the wall
4. Minimum concrete stregnth, f_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Minimum length of perpendicular wall or "jog" shall be 2 feet. Perpendicular wall shall be reinforced with same reinforcing as wall it supports.
8. Refer to Table 1B for connection requirements at the top of the wall
9. Refer to Figure 1 for basement wall detail.

Table 1B: Minimum Connection Requirements for Floodproofed Basement Walls - Full Height Walls (65 PCF)

Wall Height (ft)	Case	Sil Plate	Optional Top Plate Nailing Pattern	Anchor Bolt	Connection @ Truss	Bracing @ Walls Parallel to Trusses	
						Max. Spacing	Conn. to Sill PL
7.5	A	2-2x	16d @ 6 " o.c.	1/2" ϕ @ 20 " o.c.	A34 @ ea. Truss	4'-6"	2-A35 Clips
				5/8" ϕ @ 26 " o.c.			
				3/4" ϕ @ 32 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 8 " o.c.	2-A35 @ ea. Truss	2'-3"	2-A35 Clips
				5/8" ϕ @ 10 " o.c.			
				3/4" ϕ @ 12 " o.c.			
8	A	2-2x	16d @ 5 " o.c.	1/2" ϕ @ 18 " o.c.	A35 @ ea. Truss	4'-0"	2-A35 Clips
				5/8" ϕ @ 24 " o.c.			
				3/4" ϕ @ 30 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 9 " o.c.	2-A35 @ ea. Truss	2'-0"	2-A35 Clips
				5/8" ϕ @ 12 " o.c.			
				3/4" ϕ @ 15 " o.c.			
9	A	2-2x	16d @ 4 " o.c.	1/2" ϕ @ 14 " o.c.	A35 @ ea. Truss	3'-0"	2-A35 Clips
				5/8" ϕ @ 18 " o.c.			
				3/4" ϕ @ 22 " o.c.			
	B	2-2x	16d @ 2 " o.c.	1/2" ϕ @ 11 " o.c.	2-A35 @ ea. Truss	1'-6"	2-A35 Clips
				5/8" ϕ @ 14 " o.c.			
				3/4" ϕ @ 18 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Anchor bolts shall be ASTM F1554 Grade 36.
3. Minimum clear distance between bolt and edge of concrete shall be no less than 2 inches.
4. Minimum concrete stregnth, f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Refer to Table 1A for reinforcing requirements.
8. Refer to Figure 1 for basement wall detail.

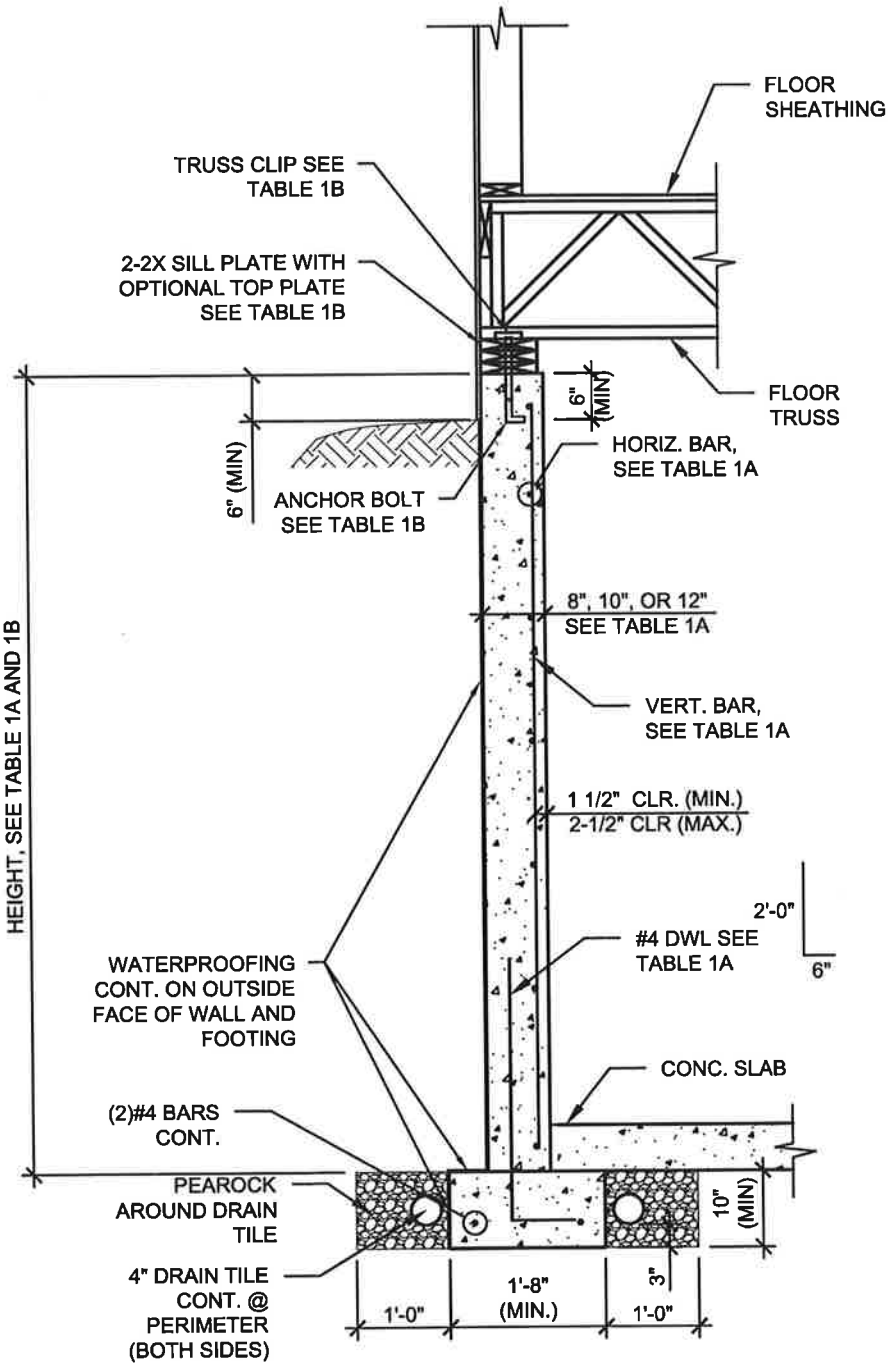

FIGURE 1: BASEMENT WALL SECTION

PRELIMINARY, NOT FOR CONSTRUCTION

Table 2: Minimum Reinforcement for Floodproofed Basement Walls - Bi-Level Walls (65 PCF)

Wall Height ft	Wall Thickness in	Vertical Reinforcing	Horizontal Reinforcing
5 (max)	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.
		# 5 @ 30 " o.c.	
		# 6 @ 40 " o.c.	
	10	# 4 @ 18 " o.c.	
		# 5 @ 26 " o.c.	
		# 6 @ 36 " o.c.	
	12	# 4 @ 12 " o.c.	
		# 5 @ 20 " o.c.	
		# 6 @ 28 " o.c.	

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the outside face of the wall.
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 2 for basement wall detail.

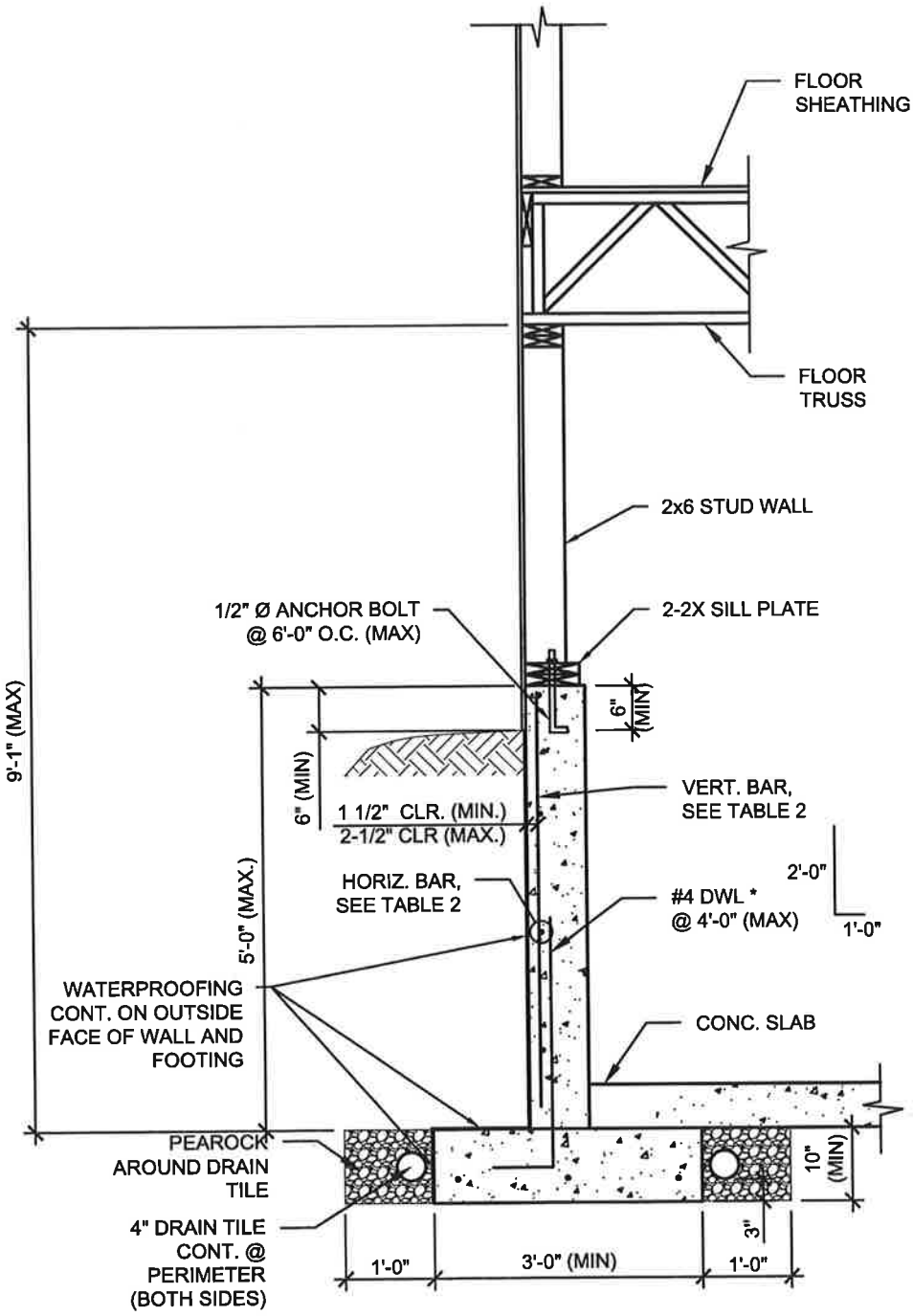

FIGURE 2: BI-LEVEL BASEMENT WALL SECTION

*NOTE: CONTRACTIORS OPTION TO SUPPLY VERTICAL REINF. WITH 1'-0" HOOK INTO FOOTING AND OMIT DOWEL BAR.

PRELIMINARY, NOT FOR CONSTRUCTION

Table 3: Minimum Reinforcement for Floodproofed Basement Walls - Window Well Walls (65 PCF)

Wall Height (ft)	Wall Thickness (in)	Horizontal Reinforcing	Vertical Reinforcing	Max. Horizontal Span (ft)
7.5	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0'
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0'
		# 4 @ 12 " o.c.		7'-6"
		# 4 @ 9 " o.c.		10'-0"
8	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0'
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0'
		# 4 @ 12 " o.c.		7'-0"
		# 4 @ 9 " o.c.		9'-6"
9	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	3'-6"
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-0"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	5'-6"
		# 4 @ 12 " o.c.		6'-6"
		# 4 @ 9 " o.c.		9'-0"

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the inside face of the wall.
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 3 for basement wall detail.

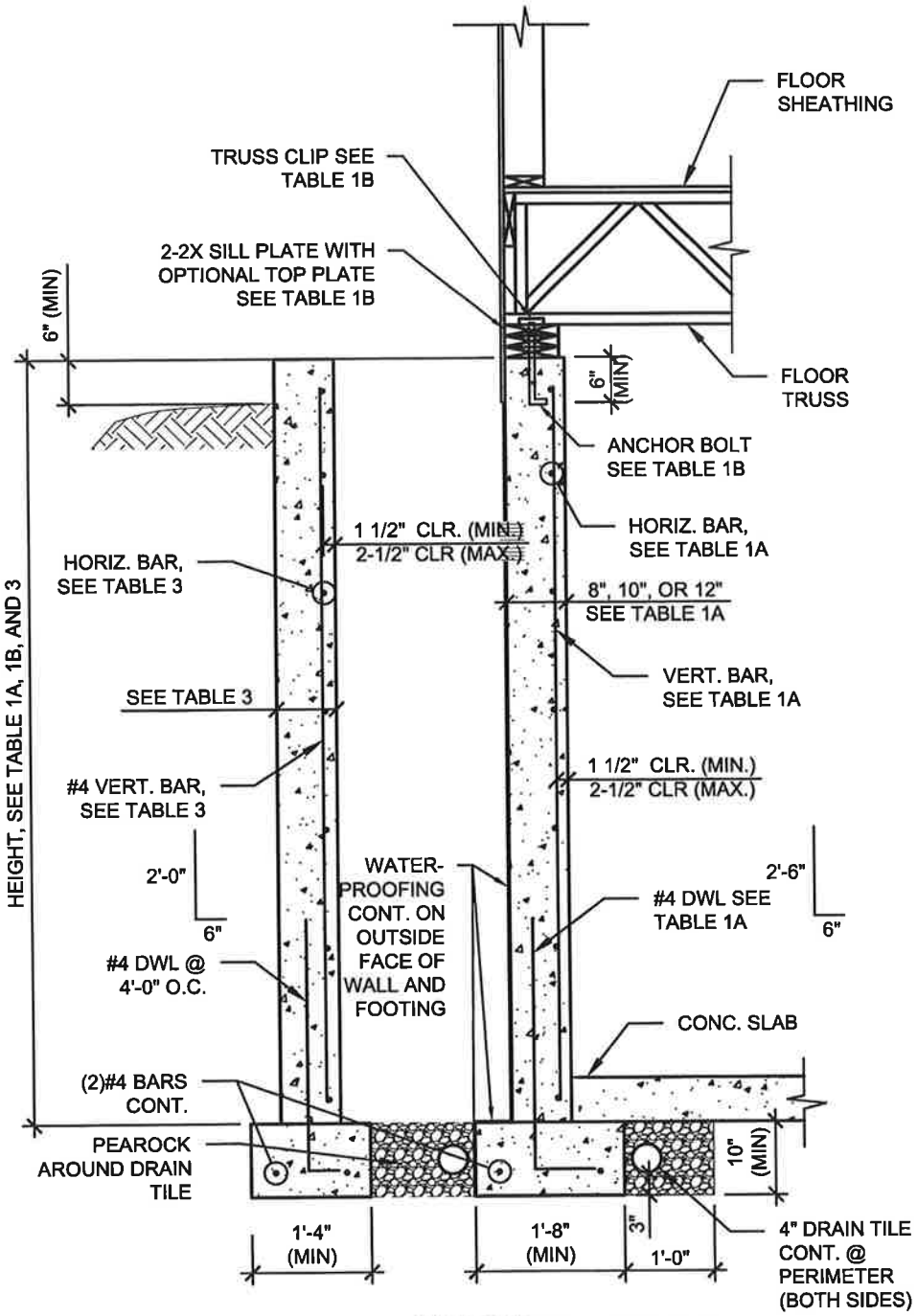

FIGURE 3: WINDOW WELL SECTION

PRELIMINARY, NOT FOR CONSTRUCTION

APPENDIX C

INSPECTION LOG FOR FOUNDATIONs

Fargo Inspections

City of Fargo
200 Third Street North
701-241-1561 phone
701-476-6779 fax

CITY OF Fargo

FLOOD PROOFING INSPECTION CARD*

Owner: _____

Address: _____

100 Year Flood Elevation: _____ Flood Protection Elevation: _____

Elevation Certification "Flood Protection Elevation"

Point of Risk: _____

Inspector: _____ Date: _____

1. Footing Date: _____ Inspector: _____
   Comments: _____
2. Foundation Date: _____ Inspector: _____
   Comments: _____
3. Waterproofing Date: _____ Inspector: _____
   Comments: _____
4. Drain Tile Date: _____ Inspector: _____
   Comments: _____
5. Sewer Line Date: _____ Inspector: _____
   Comments: _____
6. Sewer Valve Date: _____ Inspector: _____
   Comments: _____
7. Concrete Floor Date: _____ Inspector: _____
   Comments: _____

APPENDIX D

FEMA RESIDENTIAL FLOODPROOFING CERTIFICATE

Department of Homeland Security
Federal Emergency Management Agency

RESIDENTIAL BASEMENT FLOODPROOFING CERTIFICATE

See Reverse Side for Paperwork Burden Disclosure Statement

O.M.B. No. 1660-0033
Expires August 31, 2013

For use ONLY in communities that have been granted an exception by FEMA to allow the construction of floodproofed residential basements in Special Flood Hazard Areas.

BUILDING OWNER'S NAME	FOR INSURANCE COMPANY USE
	Policy Number
BUILDING STREET ADDRESS *(Including Apt., Unit Number)*	Company NAIC Number
OTHER DESCRIPTION *(Lot and Block Numbers, etc.)*	
CITY	STATE / ZIP CODE

SECTION I – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

provide the following from the FIRM and flood profile *(from Flood Insurance Study)*

COMMUNITY NUMBER	PANEL NUMBER	SUFFIX	DATE OF FIRM	ZONE	BASE FLOOD ELEVATION (IN AO ZONES, USE DEPTH)	NAME OF FLOODING SOURCE(S) AFFECTING BUILDING

SECTION II – FLOODPROOFING INFORMATION *(By a Registered Professional Engineer or Architect)*

Floodproofing Design Elevation Information:

Building is floodproofed to an elevation of _____. ____feet.
(Elevation datum used must be the same as that on the FIRM.)

Elevation of the top of the basement floor is _____. ____feet.
(Note: The floodproofing design elevation must be at least one foot above the Base Flood Elevation [BFE])

SECTION III – CERTIFICATION *(By a Registered Professional Engineer or Architect)*

Residential Floodproofed Basement Construction Certification:

I certify that, based upon development and/or review of structural design specifications, and plans for construction, including consideration of the depth, velocity, and duration of flooding and the type and permeability of soils at the site, the design and methods of construction of the floodproofed basement to be used are in accordance with accepted standards of practice for meeting the following provisions:

- Basement area, together with attendant utilities and sanitary facilities, is watertight to the floodproofing design elevation with walls that are impermeable to the passage of water without human intervention; and
- Basement walls and floor are capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy resulting from flooding to the floodproofing design elevation; and have been designed so that minimal damage will occur from floods that exceed the floodproofing design elevation; and
- Building design, including the floodproofing design elevation, complies with community requirements.

I certify that the information on this certificate represents my best efforts to interpret the data available. I understand that any false statement may be punishable by fine or imprisonment under 18 U.S. Code Section 1001.

CERTIFIER'S NAME	LICENSE NUMBER *(or affix Seal)*	
TITLE	COMPANY NAME	
ADDRESS	CITY / STATE / ZIP	
SIGNATURE	PHONE NO.	DATE

Copies of this certificate must be given to: 1) the community official; 2) the insurance agent; and 3) the building owner.

PAPERWORK BURDEN DISCLOSURE STATEMENT

Residential Basement Floodproofing Certificate
FEMA Form 086-0-24

Public reporting burden for this data collection is estimated to average 3.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and submitting this Residential Basement Floodproofing Certificate. You are not required to respond to this collection of information unless a valid OM B control number is displayed in the upper right corner of this Residential Basement Floodproofing Certificate.

Send comments regarding the accuracy of the burden estimate and any suggestions for reducing the burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472, Paperwork Reduction Project (1660-0033) **NOTE: Do not send your completed form to this address.**

APPENDIX C

28 YEARS OF SUCCESSFUL FLOODPROOFING IN THE RED RIVER VALLEY OF NORTH DAKOTA AND MINNESOTA

28 Years of Successful Floodproofing in the Red River Valley of North Dakota and Minnesota

S. Bruce Langness, P.E., MBA
Joel Quanbeck, AICP
Ulteig Engineers, Inc.

Introduction

Since 1995, the floodproofing codes of Fargo, North Dakota, Moorhead, Minnesota, and adjacent communities have met the test of time. These codes address all construction within the 100 year floodplain with particular attention given to the construction of basements for residential structures. Homes have been built in the floodplain of the Red River of the North within the communities of Fargo-Moorhead, and adjacent rural area. These homes were built with floodproof basements with the basement floor below the 100 year base flood elevation (BFE).

The record flood of 1997 as well as three spring floods and three summer floods since 1969 caused no damage to the basements built in accordance with the community floodplain management ordinance.

Fargo and Moorhead are two of 21 communities in North Dakota and Minnesota granted basement exceptions by FEMA. These communities have adopted floodplain management regulations which has allowed the construction of approximately 600 residential basements in Special Flood Hazard Areas (SFHA=s). Following the 1997 flood, FEMA gathered data of the performances of basements in the Fargo-Moorhead area.

Development of Floodproof Basement

In the early 1970's, the real estate and building industries in the Red River Valley of Minnesota and North Dakota sought relief from the Flood Insurance Administration (FIA) requirements that prohibited the construction of basements in the SFHA. Some of the reasons given for relief included:

$ The tornado history in the area; basements provide a shelter.

$ The local building code requires that foundation footings be extended down to a frost depth of 5 feet below grade. Under these circumstances, a basement can be constructed at a small increased cost.

$ Flood waters in the area rise very slowly; residents have adequate warning in advance of impending floods.

Following the historic flood of 1969, the communities studied the performance of basements and found that

reinforced concrete basements performed successfully over other types of basements. Consequently, the reinforced concrete basement design was submitted to the FIA in 1975 for approval for residential construction in shallow flooding areas of the SFHA.

FEMA responded by allowing communities in North Dakota and Minnesota to enact floodplain management ordinances that permitted the construction of residential basements. Communities that petitioned FEMA were allowed hardship under 44 CFR 60.6(b), variances and exceptions.

Criteria for Basement Exemption

In 1986, FEMA established regulations that allowed communities to propose standards for the construction of floodproofed residential basements. These regulations specify technical and administrative requirements that must be met for floodproofed basements to be allowed. Some of the technical requirements are described below:

$ Flood Conditions B Flood depths must be not greater than 3 or 5 feet depending on the lot, flood velocities must be 5 feet per second or less, and flood warning times must be at least 12 hours.

$ Structural Design Conditions B The basements must be designed to resist hydrostatic and hydrodynamic loads; the basements must be watertight without human intervention, and the floodproofed design level must be 1 to 2 feet above the BFE depending on flood elevations.

The structural design, specifications, and construction methods must be certified to be consistent with the accepted standards of practice. These basements are also inspected by a community official.

Characteristics of Fargo-Moorhead Floodproof Basement

The Fargo-Moorhead floodproof basement is a design unique to the Red River Valley. The successful performance involves six features working together. Eliminating any one of the features threatens its performance. These features are:

1. Reinforced concrete footings, walls, and basement floor.
2. Low-permeability of the Red River Valley clay soil.
3. Exterior and interior foundation drain tile and interior sump pump.
4. Elevating the structure including the ground surrounding it.
5. Constructing the basement floor less than 5 feet below the BFE.

6. Constructing the basement walls with no openings below the BFE.

A shutoff valve is installed on the sewer service line for protection against sewer backup. In addition, construction plans are reviewed by a Registered Engineer or Architect and certified as meeting the floodproof requirements upon the issuance of a building permit. During construction the basements are inspected for compliance with the floodproof design. In new residential developments in the SFHA, the entire lot is elevated above the BFE with the exception of deep river lots. On these lots, only the buildable area is elevated above the BFE. Not all developments occur within the SFHA. Some areas are naturally above the 100 year floodplain.

Flood History

The Red River of the North flows north towards Winnipeg, Canada, forming a meandering border between North Dakota and Minnesota. The land is very flat with a drop in elevation of 1 to 1-1/2 foot per mile. The drainage area of the Red River at Fargo-Moorhead is 6800 square miles with a channel capacity of 7000 cfs. The 1969 flood exceeded the capacity of the river channel by 3.6 times. Flooding occurs when the river stage is 21.3 feet below the BFE.

As a result, flood waters spread out and inundate large areas. Damaging floods from snowmelt, high intensity rains, or a combination of both occur in the subbasin almost on an annual basis in the Fargo/Moorhead area. Snowmelt floods result from snow accumulation over the winter months followed by rapid thaws in March, April, and sometimes early May. Because summer storms are generally localized, they usually do not affect the main stem area nearly as much as other subbasins; however, the July 1975 storm was an exception. Numerous large floods have occurred since the earliest recorded flood history data. Before the 1997 event, the largest floods occurred in 1882, 1897, 1952, 1965, 1966, 1969, 1975, 1978, 1979, and 1989. The 1969 flood came within one foot of the BFE in Fargo-Moorhead. The next nearest flood in recent history was the flood of 1989 which came within 3 feet of the current 1999 BFE. The all time record flood of 1897 exceeded the current 1999 BFE by 1.3 foot. The most recent event was the summer flood of 2000 in which 6.9 inches fell within 8 hours in the Fargo-Moorhead area. Although there were many areas of localized flooding and much damage to residential property, no damage occurred in floodproofed homes.

Benefits of Floodproofed Basements

The approximately 600 homes with floodproofed basements are located throughout the Fargo-Moorhead area in over 24-developments on both sides of the Red River. Having survived the 1997 flood without any structural damage or even wet carpets in these basements, the performance was successful. The benefit of having this level of protection lessens flood damage. In addition to providing shelter during tornados, the benefit of the added living space a basement provides is significant. A basement doubles the living space for a single story house, thereby lessening the footprint size of the building.

The benefit of the reinforced concrete basement adds long term value to the house by providing a more stable foundation system for the building. The reinforced concrete walls withstand long term swelling and shrinking loads from the expansive clay soils during annual wet and dry periods. Except for occasional wood foundation structures in non-SFHA areas, the reinforced concrete basement has become the standard construction practice since the concrete masonry block era of the 1950's and early 1960's. Lastly, the benefit of having a local floodproofing ordinance has eliminated the construction of walk-out basements for new homes built along the river since 1969. The greatest flood damage occurs to pre-FIRM houses along the river that have walkout basements.

Costs

The additional cost to construct the floodproof basement amounts to 1 to 3 percent of a typical $140,000 house. The greatest cost is the amount of earthwork needed to elevate the property. This can range from $1000 to $3000 per lot. Other costs include the installation of a shutoff valve on the sewer service line and added concrete and reinforcing steel in the basement walls.

Study of Basement Performance

FEMA has been interested in gathering information about residential basement performance in areas where it has regulatory authority. One of these areas includes the basement exception communities. The April 1997 flooding in the Red River Valley provided a unique opportunity for FEMA to learn about the performance of basements in SFHA=s in the basement exception communities. A Building Performance Assessment Team (BPAT) was deployed by the Mitigation Directorate of FEMA to gather information about the factors that affect the type and amount of damage, and to study the structural performance of basements. The BPAT was also interested in the overall

performance of basements to both pre- and post-FIRM structures. The BPAT consisted of engineers from Greenhorne & O=Mara, Inc., Greenbelt, Maryland; FEMA, and Ulteig Engineers, Inc. of Fargo, North Dakota.

The study analyzed several variables of various basements on 50 homes in the Fargo-Moorhead area where the 1997 flood was above the 100-year event. High water mark elevations were obtained during the 1997 flood which show that 1997 exceeded the BFE and varied throughout the Fargo-Moorhead area with the greatest variance upstream of the community. The following table shows the elevation difference as well as a comparison with a 500 year event.

1997 Flood High Water Elevations

Location	1997 Flood High Water Elevation (1929 NGVD)	Elevation Difference: High Water to 100-Year (Feet)	Elevation Difference: High Water to 500-Year (Feet)
County Highway 20 (North Edge)	894.4	+1.2	-0.2
Main Avenue (Midway)	900.1	+1.1	-2.4
Interstate 94	902.3	+1.5	-2.5
Rose Coulee (South Edge)	905.0	+2.2	-1.3

The 1997 flood was a significant test of the Fargo-Moorhead floodproof basement. The study found flood damage costs ranging from $19,600 to pre-FIRM houses, $6,900 to post-FIRM houses outside the SFHA, but no damage to the post-FIRM floodproof houses. This lack of damage is also attributed to the successful flood preparation and flood fighting efforts undertaken by the Fargo-Moorhead community.

Lessons Learned

The 1997 Red River Valley flood provided a rare opportunity to learn, or re-learn, valuable lessons on how both the engineering of basements and their use affect flood losses to the homeowner. A community can make more informed floodplain management decisions if it understands the limits of both engineering and/or controlling the use of basements in reducing basement damages to houses built in or adjacent to the SFHA.

Significant damages in basements based on their use (contents, finishes and furnishings) occurred outside the 100-year floodplain. These basements are usually less regulated. Finishing of basements inside the 100-year floodplain is normally not a Asubstantial improvement@ as defined by the NFIP. However, basements in pre-FIRM houses in the SFHA were routinely finished leading to greater damages. These damages are not eligible under a standard flood insurance policy, or homeowner=s insurance policy.

The study found that communities can practically eliminate flood damage by requiring both strict engineering and construction standards combined with controlled use of the basements and their contents.

References

Langness, S. Bruce, P.E., Engineering Report of Existing Basements of Single Family Dwellings Under Hydrostatic Loading by the 1969 Flood, Ulteig Engineers, Inc., December 1974.

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Langness, S. Bruce, P.E., Klein, Jeff, Bittner, Mark, P.E., Strand, Ron, Tomanek, Vernon, P.E.; 24 Years of Successful Floodproofing in the Red River Valley of North Dakota and Minnesota, Ulteig Engineers, Inc., Spring 1999.

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FEMA, Flood Insurance Study, City of Moorhead, Minnesota, May 1987.

FEMA, Flood Insurance Study, County of Clay, Minnesota, April 1984.

FEMA, Flood Insurance Study, Township of Stanley, Cass County, North Dakota, September 1985.

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APPENDIX D

1% ANNUAL CHANCE FLOOD WATER DEPTH MAPPING

DEPTH OF 0.1% CHANCE FLOOD
AFTER (JANUARY 16, 2015)

LEGEND

Depth Class (Feet)

- 3 or Less
- 3.1 to 5.0
- 5.1 to 5.4
- 5.5 to 5.9
- 6.0 and up

City of Fargo and ETJ

1 inch = 2 miles

June 13, 2014

0 1 2 3 4 5 Miles

CLAY COUNTY
MINNESOTA

CASS COUNTY
NORTH DAKOTA

CITY OF FARGO

Mapleton

West Fargo

Horace

Comstock

Hector Int'l Airport

Maple River Golf Club

Meadows Golf Course

Sheyenne River

Wild Rice River

Oxbow

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

TECHNICAL MEMORANDUM

To: Nathan Boerboom, P.E., CFM
City of Fargo

From: C. Gregg Thielman, P.E., CFM
Houston Engineering, Inc.

Subject: Mapping of Floodwater Velocities

Date: November 19, 2014

HEI Project: 6059-081

ANAYLSIS

The City of Fargo contracted with Houston Engineering, Inc. to map floodwater velocities that would be experienced with in the city of Fargo during the preliminary FEMA 1% annual chance flood (Effective date projected to be 1/16/2015). To perform the analysis, the results from four different HEC-RAS models were used in order to map the overbank and channel velocities for the incorporated areas of Fargo, ND. The four models are; Fargo to Oakport Preliminary FIS model, Southern Cass/Clay FIS model, Wild Rice FIS model, and the Cass County Drain 53 model.

The model cross sections, bank stations, and the channel and overbank velocities were exported from the HEC-RAS models. The cross sections were then broken up by the bank station locations in order to create three separate corridors, one for the channel, one for the left overbank area, and one for the right overbank area. For the areas between cross sections, the boundary between the two corridors was delineated using LiDAR to determine the approximate river bank locations consistent with the bank stations in the HEC-RAS model cross sections. Using the corridors and the channel and overbank velocities, polygons were created to represent the velocities at a given location. Any areas that would be flooded due to backwater or areas where the floodwaters would not have any velocity (ineffective flow areas) were removed from the velocity mapping and are shown as the 1% Chance Floodplain. For areas along the Sheyenne River, where the effective FIS hydraulic models are not available, velocity data from the Floodway Data Tables was used to map the floodwater velocities.

Color shading was used on the mapping to differentiate between ranges of velocities. PDF maps were created to display the floodwater velocities.

Overview Map

Harwood
Sheet 1
Sheet 2
Reiles Acres
Sheet 3
West Fargo
Sheet 4
Fargo
Moorhead
Dilworth
Sheet 5
Prairie Rose
Sheet 6
Frontier
Briarwood
Horace
Sheet 7
Sheet 8

Drain 40
Red River
Sheyenne River
Drain 27
Drain 53

22
81
31
17
29
94

19th Ave N
12th Ave N
Main Ave E
13th Ave S
32nd Ave S
40th Ave S
52nd Ave S
9th St E
45th St S
25th St S
University Dr S
8th St S
Veterans Blvd S

Houston Engineering Inc.

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Fargo Floodwater Velocities

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	SMO	DCK	6059-081	10/15/2014	1 of 8

HoustonEngineering Inc.

- FIS Cross Sections
- FEMA 1% Chance Floodplain
- Minimum Disturbance Zone Setback
- Limited Disturbance Zone Setback
- Fargo City Limits
- Fargo ET Limits

Floodwater Velocity (ft/s)

- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5

0 2,500 5,000 Feet

N

29 81 22 17

28TH ST SE 171ST AVE SE 172ND AVE SE 29TH ST SE 170TH AVE SE

INTERSTATE BLVD TRUMAN DR CHAPIN DR LIND BLVD MAIN ST DAKOTA AVE

ASH LN 76TH AVE N 64TH AVE N 66TH ST N 81ST ST N 52ND AVE N 57TH ST N 47TH ST N 45TH ST N 40TH AVE N LANDVIEW RD N 14TH ST NW

LOWER BRANCH RUSH RIVER RUSH RIVER SHEYENNE RIVER MAPLE RIVER

COUNTY DRAIN 40 COUNTY DRAIN 45

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z AA

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28TH ST SE
172ND AVE SE
173RD AVE SE
29TH ST SE
COUNTY DRAIN 40
DRAIN 10 BREAKOUT
RED RIVER OF THE NORTH
76TH AVE N
37TH ST N
45TH ST N
64TH AVE N
52ND AVE N
25TH ST N
17TH ST N
15TH ST N
13TH ST N
16TH ST N
10TH ST N
UNIVERSITY DR N
BROADWAY N
31ST ST N
33RD ST N
32ND ST N
43RD ST N
37TH ST N
OLD US HWY 81 N
COUNTY DRAIN 40

AB AC AD A B C AE AF E F G H I AG AH AI AJ AK AL AM AN AO AP AQ AR AS AT AU

31 31 81

0 2,500 5,000 Feet

FIS Cross Sections
FEMA 1% Chance Floodplain
Minimum Disturbance Zone Setback
Limited Disturbance Zone Setback
Fargo City Limits
Fargo ET Limits

Floodwater Velocity (ft/s)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5

Fargo Floodwater Velocities

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HoustonEngineering Inc.

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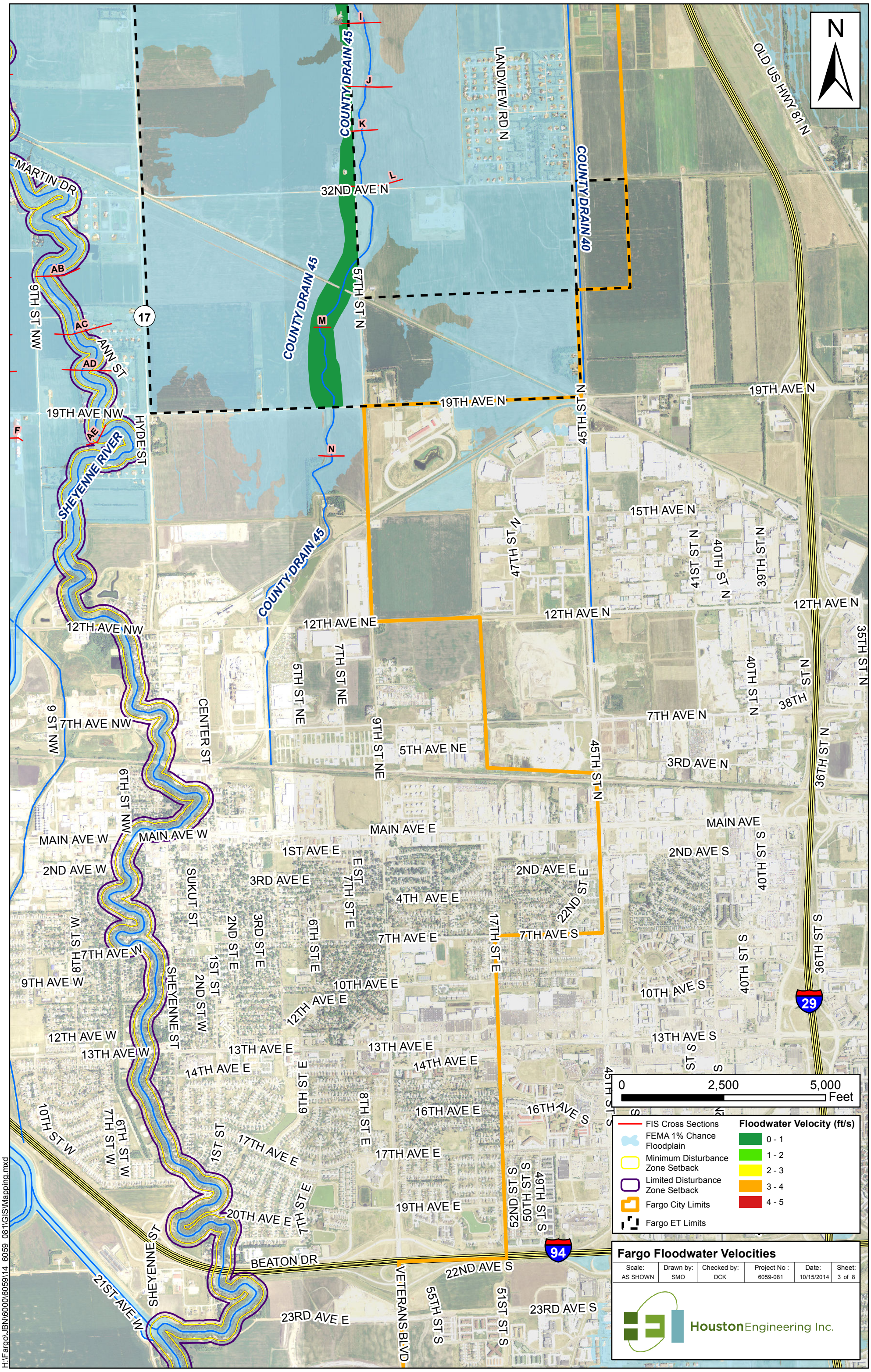

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RED RIVER OF THE NORTH

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33RD ST N
32ND ST N
31ST ST N
25TH ST N
40TH AVE N
19TH ST N
10TH ST N
KANDI LN N
EVERGREEN RD N
1ST ST N
2ND ST N
PAR ST N
32ND AVE NE
9TH ST N
7TH ST N
30TH AVE N
MAPLE ST N
LILAC LN N
VOODOO DR N
DAKOTA DR N
OLD US HWY 81 N
14 ST N
28TH AVE N
UNIVERSITY DR N
12TH ST N
9 1/2 ST N
10TH ST N
25TH AVE N
23RD AVE N
ELM ST N
21ST AVE N
20TH AVE N
19TH AVE N
BROADWAY N
3RD ST N
15TH AVE N
11TH ST N
8TH ST N
6TH ST N
5TH ST N
18TH ST N
BOLLEY DR N
12TH AVE N
11TH AVE N
4TH ST N
OAK ST N
16TH ST N
COLLEGE ST N
14TH ST N
8TH AVE N
TERRACE N
6TH AVE N
35TH ST N
28TH ST N
29TH ST N
26TH ST N
27TH ST N
25TH ST N
24TH ST N
19TH ST N
5TH AVE N
3RD AVE N
15TH ST N
36TH ST N
1ST AVE N
MAIN AVE
34TH ST S
27TH ST S
24TH ST S
23RD ST S
22ND ST S
21ST ST S
18TH ST S
1ST AVE S
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3RD AVE S
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7TH AVE S
8TH AVE S
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8TH ST S
ROGER MARIS DR S
94

0 2,500 5,000 Feet

FIS Cross Sections
FEMA 1% Chance Floodplain
Minimum Disturbance Zone Setback
Limited Disturbance Zone Setback
Fargo City Limits
Fargo ET Limits

Floodwater Velocity (ft/s)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5

Fargo Floodwater Velocities

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Fargo Floodwater Velocities

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Houston Engineering Inc.

FIS Cross Sections
FEMA 1% Chance Floodplain
Minimum Disturbance Zone Setback
Limited Disturbance Zone Setback
Fargo City Limits
Fargo ET Limits

Floodwater Velocity (ft/s)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5

0 2,500 5,000 Feet

N

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Fargo Floodwater Velocities

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- FIS Cross Sections
- FEMA 1% Chance Floodplain
- Minimum Disturbance Zone Setback
- Limited Disturbance Zone Setback
- Fargo City Limits
- Fargo ET Limits

Floodwater Velocity (ft/s)

- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5

0 2,500 5,000 Feet

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13TH AVE S
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15TH AVE S
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18TH AVE S
19TH AVE S
20TH AVE S
21ST AVE S
25TH AVE S
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26TH AVE S
30TH AVE S
33RD AVE S
34TH AVE S
35TH AVE S
36TH AVE
38TH AVE S
38 1/2TH AVE S
40TH AVE S
42ND AVE S
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25TH ST S
27TH ST S
28TH ST S
32ND ST S
33RD ST S
34TH ST S
35TH ST S
38TH ST S
BISHOPS BLVD S
UNIVERSITY DR S
RIVER DR S

ROGER MARIS DR S
RED RIVER OF THE NORTH
ROSE COULEE, DRAIN #27
DRAIN 53 BREAKOUT

BN BO BP BQ BR BS BT BU BV BW BX BY BZ CA CB CC CD CE CF CG CH CI CJ CK A B C D F G H

29

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SHEYENNE RIVER
MAPLE LN
ELLIS LN
SUNNYSIDE ST
75TH ST S
17
BRINK DR
70TH ST S
LAKEVIEW DR
3RD ST N
5TH ST N
MAIN ST
WALL AVE
PARK DR
NELSON DR
3RD ST E
4TH ST E
76TH AVE S
88TH AVE S
57TH ST S
45TH ST S
38TH ST S
DRAIN 53 BREAKOUT
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100TH AVE S
72ND ST S
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ROSE COULEE, DRAIN #27
112TH AVE S
124TH AVE S
Y
171ST AVE SE
172ND AVE SE
49TH ST SE
AE
AF
WILD RICE RIVER

0 2,500 5,000 Feet

FIS Cross Sections
FEMA 1% Chance Floodplain
Minimum Disturbance Zone Setback
Limited Disturbance Zone Setback
Fargo City Limits
Fargo ET Limits

Floodwater Velocity (ft/s)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5

Fargo Floodwater Velocities

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HoustonEngineering Inc.

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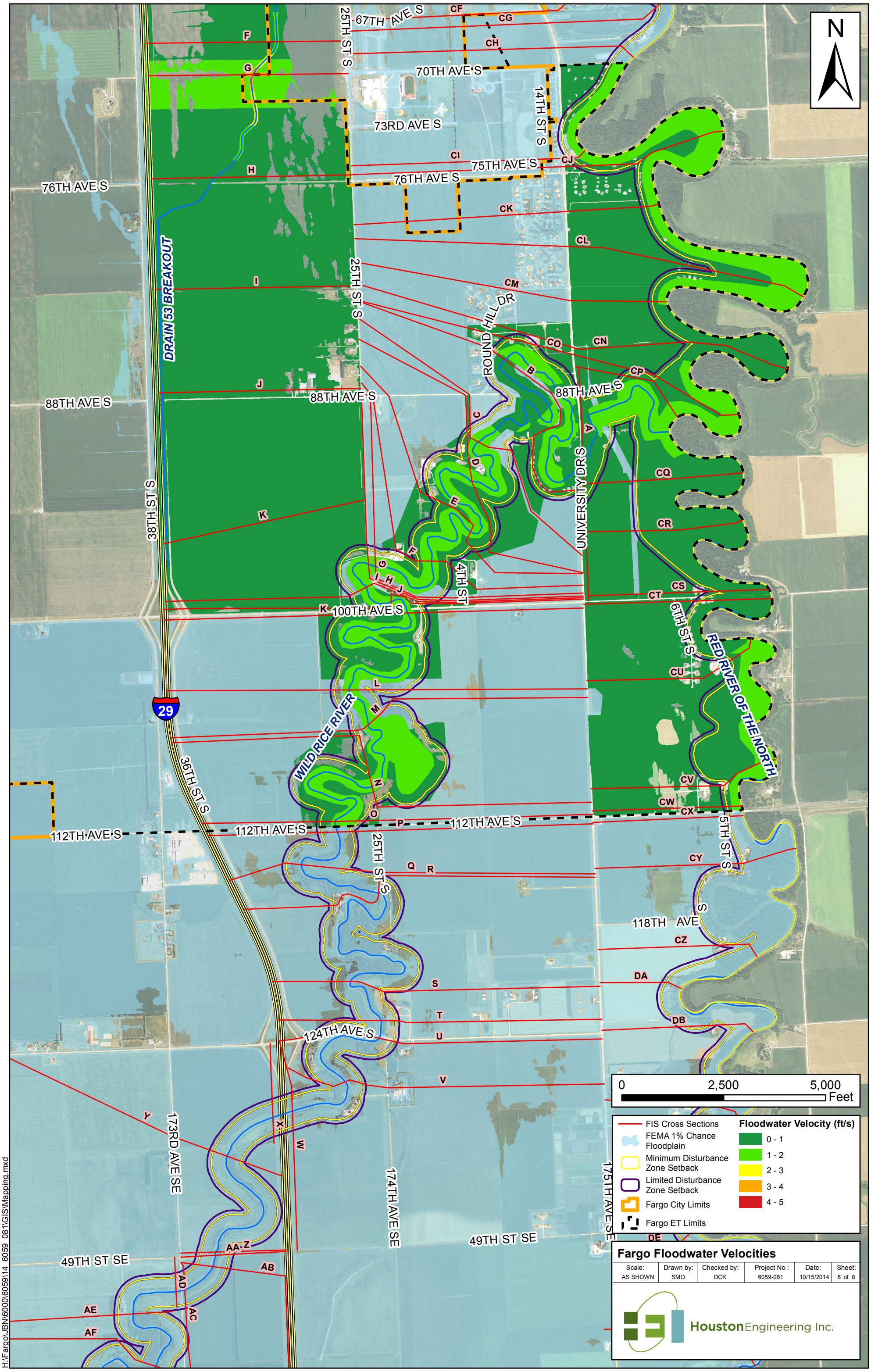
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118TH AVE S
124TH AVE S
49TH ST SE
25TH ST S
14TH ST S
38TH ST S
36TH ST S
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5TH ST S
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174TH AVE SE
175TH AVE SE
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UNIVERSITY DR S
DRAIN 53 BREAKOUT
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RED RIVER OF THE NORTH
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CL
CM
CN
CO
CP
CQ
CR
CS
CT
CU
CV
CW
CX
CY
CZ
DA
DB
DE
0
2,500
5,000
Feet
FIS Cross Sections
FEMA 1% Chance Floodplain
Minimum Disturbance Zone Setback
Limited Disturbance Zone Setback
Fargo City Limits
Fargo ET Limits
Floodwater Velocity (ft/s)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
Fargo Floodwater Velocities
Scale: AS SHOWN
Drawn by: SMO
Checked by: DCK
Project No : 6059-081
Date: 10/15/2014
Sheet: 8 of 8
HoustonEngineering Inc.
H:\Fargo\JBN\6000\6059\14 6059 081\GIS\Mapping.mxd

APPENDIX F

PAST RED RIVER SPRING FLOOD HYDROGRAPHS

FLOOD GRAPH

Historical Crests for Red River of the North at Fargo
Source: National Weather Service
Advanced Hydrologic Prediction Service
Date: 3/21/2013

(1) 40.84 ft on 03/28/2009
(2) 39.72 ft on 04/18/1997
(3) 39.10 ft on 04/07/1897
(4) 38.81 ft on 04/09/2011
(5) 37.34 ft on 04/15/1969
(6) 37.13 ft on 04/05/2006
(7) 36.99 ft on 03/21/2010
(8) 36.69 ft on 04/14/2001
(9) 35.39 ft on 04/09/1989
(10) 34.93 ft on 04/19/1979

17' Gauge = 881.33 Elev. (City of Fargo)
17' Gauge = 878.80 Elev. (U.S.G.S.)

APPROX. AVG. RISE
1969–3.22 ft./Day
1975–1.07 ft./Day
1979–2.39 ft./Day
1989–2.47 ft./Day
1997–1.45 ft./Day
2001–1.87 ft./Day
2006–3.20 ft./Day
2007–1.84 ft./Day
2009–3.26 ft./Day
2010–2.37 ft./Day
2011–2.08 ft./Day

Approx. Max. Rise/Day
1969–5.10 ft./Day
1975–4.55 ft./Day
1979–3.42 ft./Day
1989–3.94 ft./Day
1997–4.02 ft./Day
2001–3.85 ft./Day
2006–5.03 ft./Day
2007–3.26 ft./Day
2009–4.92 ft./Day
2010–3.26 ft./Day
2011–3.98 ft/Day

APPROX. AVG. DECLINE
1969–0.77 ft./Day
1975–1.15 ft./Day
1979–1.05 ft./Day
1989–1.44 ft./Day
1997–0.75 ft./Day
2001–0.62 ft./Day
2006–1.28 ft./Day
2007–0.56 ft./Day
2009–0.43 ft./Day
2010–0.58 ft./Day
2011–0.32 ft./Day

Saturday (00:15 A.M.)–March 28, 2009 (40.82)
40.82'/2009
Friday (1:00 A.M.)–April 18, 1997 (39.72)
Saturday (6:15 P.M.)–April 9, 2011 (38.75)
Thursday (05:30 A.M.)–April 16, 2009 (34.00)
1969 (37.32)
2006 (37.18)
2010 (36.99)
2001 (36.70)
1989 (35.26)
1979 (34.75)
1975 (31.85) cfs adjusted
2007 (30.85)
Major 30
Moderate 25
Flood Stage 18
17' Action Stage

BASED ON 1969 FLOOD (April 8 to May 12)
BASED ON 1975 FLOOD (June 20 to July 18)
BASED ON 1979 FLOOD (April 13 to May 4)
BASED ON 1989 FLOOD (April 3 to April 17)
BASED ON 1997 FLOOD (April 2 to May 30)
BASED ON 2001 FLOOD (April 4 to June 4+)
BASED ON 2006 FLOOD (March 30 to April 20+)
BASED ON 2007 FLOOD (March 20 to July 10)
BASED ON 2009 FLOOD (March 20 to May 20)
BASED ON 2010 FLOOD (March 13 to April 23)
BASED ON 2011 FLOOD (March 30th to June 13th)
BASED ON 2013 FLOOD (April ?? to May ??)

(readings for the Spring 2013 event are taken at 05:00 AM CDT each day)

KJRheault
3/21/2013
T:\Engineering\Flood\2013\2013_Fldgraph.dwg

APPENDIX G

FLOODPROOF BASEMENT STRUCTURAL DESIGN REPORT

728 East Beaton Drive Suite 101
PO Box 190
West Fargo, ND 58078-2650
701 232 5353
kljeng.com

November 20, 2014

Nathan Boerboom, PE
Civil Engineer
City of Fargo
200 North 3rd Street
Fargo, ND 58102

Re: City of Fargo Project #MS-14-71-Floodproof Basement Structural Review

Dear Mr. Boerboom:

KLJ was asked to review the structural requirements of the City's existing Floodproofing Code. Our review included a literature review of the documents used to generate the existing floodproofing code, comparison of the existing floodproofing code to current industry practices and building codes, and analysis of basement wall designs included in the existing floodproofing code. A summary of our findings and resulting conclusions are provided in the following sections.

Floodproofing Document Review

The following is a summary of our review of the documents prepared for and in regards to the existing Floodproofing Code.

1. *Structural Evaluation of Basement Walls for Single Family Dwellings Under Hydrostatic Loading for The Fargo-Moorhead Home Builders Association Fargo, North Dakota* by S. Bruce Langness (August 1974).
    a. The report reviewed three basement wall details common to the Fargo area.
    b. Design was reviewed using the Uniform Building Code (current edition) and the American Concrete Institute (ACI) 318-71.
    c. Determined the typical hydrostatic pressure for soils in the area was 120 pounds per cubic foot/foot depth (PCF/FT) when fully saturated.
    d. Seepage would be a week with newly backfilled home and a month for older homes.
    e. The hydrostatic swell pressures in the clay would develop prior to hydrostatic loading and would not act concurrently. Hydrostatic pressures would be the controlling pressure against the walls.
    f. The analysis only focused on the 8" concrete wall.
    g. The design parameters included:
        i. Wall height = 7'-6"
        ii. Wall thickness = 8"
        iii. Hydrostatic pressure equal to zero at bottom of window sill
        iv. Wall is simply supported at the top and bottom

v. Minimum reinforcing based on the UBC and ACI:
    1. Vertical = #4 at 18" on center
    2. Horizontal = #4 at 12" on center
    3. Two (2) #5 bars extending 24" outward from each corner of openings
vi. Clear distance from the outside face = 6"

h. In conclusion, the report stated that if the walls were to be reinforced, they should follow the minimum requirements of the UBC and the ACI. However, the author also states the three details of the typical basement construction in the Fargo area performed satisfactory in the past and "no significant problems occurred with cast-in-place concrete walls because of this flood [1969]."

2. *Engineering Report of Existing Basements of Single Family Dwellings Under Hydrostatic Loading by the 1969 Flood for The Fargo-Moorhead Home Builders Association and Fargo-Moorhead Board of Realtors Fargo, North Dakota* by S. Bruce Langness (December 1974).
    a. The report was generated to review performance of basement construction during the 1969 flood and prepare design recommendations for future construction.
    b. The study included the visual observation of seven basements in the Red River Valley that sustained flood damage. The homeowners interviewed at the time the study were the same during the 1969 flood. The homes ranged in age from 6 to 20 years old.
    c. The report stated 207 homes sustained flood damage during the flood, but none of the homes had structural damage. Some of the homes sustaining flood damage had been intentionally flooded with clean water to relieve hydrostatic loading on the basement walls.
    d. The exterior grade on the basements surveyed was within 8 to 10 inches below the top of the basement wall. The height of the flood water against some of the basements was 12 inches above the existing grade. This led to the conclusion that future basements should be constructed with existing grade being below the bottom of the window openings and above the 100 year flood elevation.
    e. The height of the flood waters in the 1969 flood were estimated to be 6-12 inches below the 100 year flood elevation.
    f. All of the walls surveyed performed satisfactory but none of them met the minimum reinforcing criteria for the ACI and were therefore classified as unreinforced walls.
    g. Study determined the existing wall construction would not be adequate to withstand fully saturated hydrostatic pressures (120 PCF/FT) identified in a previous report, and concluded the pressure on the walls was being relieved by the subsurface drainage system. However, it also stated that in the future the walls should be designed to accommodate the fully saturated hydrostatic pressure conditions.

h. Temperature and shrinkage cracks were found to exist in all of the walls studied. However, the presence of the cracks did not lead to seepage from the exterior flood waters. The author stated these cracks are common and are not cause for concern, but additional temperature and shrinkage reinforcement could be installed in the walls to minimize the cracks in the future.
i. The author concluded that uplift pressures imposed by the flood waters on the basement slab could be controlled with the presence of drain tile below the slab placed in a coarse granular fill. The drainage system should be designed to accommodate a flow of 8-40 gallons of water per hour.
j. The study concluded that past performance of typical basement construction in the Red River Valley has performed satisfactorily without any significant structural damage. However, future consideration should be given to the following:
    i. Exterior backfill should consist of well compacted, clayey soils.
    ii. Utility trenches adjacent to basements should be backfilled with well compacted, clayey soils.
    iii. Drainage systems should be installed around the perimeter of the basement walls and below the basement slab.
    iv. Analysis of basement walls for fully saturated hydrostatic pressures.
    v. The bottom of window openings should be kept above grade and above the 100 year flood elevation.
    vi. Temperature and shrinkage reinforcing could be added to the walls to minimize shrinkage cracks.

3. *Investigation of Basement Construction in Fargo, North Dakota and Moorhead, Minnesota, Area* by NAHB Research Foundation, Inc. (June 1975).
    a. This document was prepared in response to the proposed Floodproofing Code drafted by the City of Fargo by the National Association of Home Builders.
    b. The authors infer that the intent of the previous two documents reviewed herein was not to modify the design of floodproofed basement walls to withstand an hydrostatic pressure of 120 PCF, but rather to illustrate the walls currently being built have performed well and have not been subjected to this high of pressure.
    c. According to the authors, basement construction in the area would cease to exist if the design requirements were increased to 120 PCF as the cost of the basement construction would likely triple. In addition, they suspect the basement floor slab would need to be increased to nearly 27 inches in thickness to withstand buoyancy forces generated by hydrostatic pressures of 120 PCF.
    d. Recommendations for modifying the proposed Floodproofing Code for the City of Fargo included in the document are summarized as follows:
        i. The minimum elevation to the bottom of openings in basement walls should be kept 6 inches above the base flood elevation and the exterior grade shall maintain a minimum slope of 5 percent within the first 10 feet from a basement.

ii. The vertical reinforcing shall be placed 2 inches from the inside face of the wall. The horizontal reinforcing shall overlap a minimum of 12 inches at the corners. The #4 dowels used to connect the wall to the footing shall have a vertical leg of 24 inches and horizontal leg of 5 inches. There should be two #4 bars placed around each opening that extend a minimum of 12 inches beyond the opening.
iii. The concrete parameters should be identified in the Code.
iv. The design should follow the ACI 322-72 for structural plain concrete.
v. The height of the soil against the walls should be assumed to be 5'-4" above the basement floor slab for 2,500 PSI concrete.
vi. The sump pump criteria should be specified, including the provision for four (4) connections between the interior and exterior drain tile.
vii. The backfill for basement walls and utility trenches should be Unit 3 soils, clayey and impermeable, and well compacted.

e. Additional studies were identified as follows:
   i. Determination of proper compaction requirements to maintain impermeable nature of soils.
   ii. Establishment of equivalent lateral earth pressure for soils native to the area which should include a seepage analysis.
   iii. Determine percolation rates of the soil into the drainage system around the perimeter of the basement.

f. Documents included in the Appendix are as follows:
   i. Appendix A is a list of field notes regarding the NAHB visit to Fargo on May 19-23, 1975.
   ii. Appendix B includes a letter to Mr. Hugh Angleton of Laboratory Services from Mayor Richard A. Hentges of the City of Fargo regarding updated estimates to the number of homes sustaining flood damage in the 1969 flood.
   iii. Appendix C includes design calculations prepared by Ulteig Engineers, Inc. presumably by S. Bruce Langness dated August 8, 1974.
      1. Calculations are based on an 8" concrete wall with a height of 7'-6". The finished grade is assumed to be 8" below the top of the wall and the 100 year flood elevation is 2 feet below the top of the wall. The wall was assumed to be simply supported.
      2. The equivalent saturated soil pressure is assumed to be 120 PCF below the 100 year flood elevation and 77 PCF above this elevation. The average factored equivalent fluid pressure was determined to be 144 PSF/FT or PCF.
      3. The analysis determined the vertical reinforcing to be #4 bars spaced at 18" on center and horizontal reinforcing to be #4 bars at 12" on center.

4. Calculations were not included for the connections at the top and bottom of the wall.
5. Three details accompanied the calculations that included a typical basement wall section, basement floor and reinforcing plan, and basement floor reinforcing details. The floor slab is shown to be placed integral with the basement slab and is 7" thick and reinforced with #7 bars at 9" on center in each direction. The wall and floor sections call for PVC waterstop to be placed at the intersection of the walls and floor.

iv. Appendix D is photographs of typical home construction in the Fargo area.

v. Additional reports and letters are attached to the end of the document and include:

1. Letter to the U.S. Department of Housing and Urban Development from Mr. John Wambheim the Executive Secretary of the Fargo-Moorhead Builders & Realtors dated December 11, 1974.
2. *Engineering Report of Existing Basements of Single Family Dwellings Under Hydrostatic Loading by the 1969 Flood for The Fargo-Moorhead Home Builders Association and Fargo-Moorhead Board of Realtors Fargo, North Dakota* by S. Bruce Langness (December 1974).
3. Letter from Edwin D. Foss of Camrud-Foss Construction Co., Inc. to Mr. John Wambheim of the Fargo-Moorhead Home Builders Association dated August 27, 1974.
4. *Flood Proofing Code of the City of Fargo, North Dakota* by Moore Engineering, Inc. (December 9, 1975).

4. *Addendum to Investigation of Basement Construction in Fargo, North Dakota and Moorhead, Minnesota, Area* by NAHB Research Foundation, Inc. (August 1975).
   a. Members of the NAHB visited Fargo after a flood in July 1975 to review performance of four (4) homes constructed in conformance with the proposed City of Fargo Floodproofing Code. The homes were recently constructed, and only one of them was finished. All four homes were constructed with the interior and exterior drainage system, but only the finished house had a sump pump installed. In all cases, the NAHB observed the flow of water into the sump from the drain tile to be "a steady trickle".
   b. The report also includes comparison between Floodproofing Codes prepared by the Cities of Grafton and Fargo, North Dakota. It determined the main difference was in regards to the height of backfill above the basement floor elevation. The Grafton Code used 6'-7" whereas the Fargo Code referenced 5'-4".
   c. The report concluded the use of a hydrostatic pressure of 120 PCF is conservative due to the low probability that this will occur due to the installation of the drainage system. A pressure of 90 PCF was determined to be more reasonable.

d. Two design charts are provided for 7'-6" and 8'-0" tall basement walls respectively. The charts provide maximum backfill heights for given lateral pressures and concrete strengths.

5. *Flood Proofing Code of the City of Fargo, North Dakota* by Moore Engineering, Inc. (December 9, 1975).
    a. Chapter 5 discusses the Flood-Proof Construction Types. The types of construction under consideration for the purpose of this report are considered Type FP 2. Based on Table 1 waterproofing is required to be Type D and structural loads are Class 4.
    b. Type FP 2 construction shall meet the requirements found in Figures 1a, 1b, 2a and 2b of the document. The minimum elevation of an opening shall be 6" above the flood protection elevation. Wall penetrations are only allowed when enclosed by a window well per Figures 2a and 2b. Backfill shall consist of clayey soils and be well compacted. An underdrain system shall be provided as per Figures 1a and 1b. The basement walls are to be design as structural plain concrete as per ACI 322-72 with a minimum concrete strength of 3,000 psi and minimum reinforcing strength of 40,000 psi.
    c. Chapter 6 covers waterproofing requirements. For Type FP 2 structures, Type D waterproofing is recommended. This includes two (2) coats manufactured by Southwest Grease, Kansas City Missouri (fortress foundation coating or equal). The waterproofing "shall be substantially impermeable to the passage of free ground water."
    d. Chapter 7 covers the structural requirements for floodproofed structures.
        i. Class 4 loads required for FP 2 construction are "those loads required by the Building Code."
        ii. Section 7.03 covers the types and definitions for water loads. Section 7.03.e discusses when hydrostatic and hydrodynamic loads are required to be used. When water velocities exceed 5 feet per second (fps), only hydrostatic loads need be applied to a structure.
        iii. Section 7.04 discusses the impact loads. Based on our review of the impact load definitions, these do not apply to homes constructed as per Exhibits A and B in the *Floodproof Construction Requirements* for the City of Fargo (March 2014). With a 15 foot setback and freeboard of +0.7ft above WSEIA elevation, flood waters should not reach the buildings.
        iv. As per Section 7.05: Soil Loads, buildings should be designed to accommodate soil loads based on "accepted engineering practice." The soil loads should account for "presence of flood water, above or within the soil."
        v. The building code in effect at the time the building is constructed should be used to determine the design loads and load combinations. Section 7.07 states the dead, snow and wind loads determined from the building code should be used in full intensity when considering flood loads. Live loads can be reduced per the building code, and should be used when their

effects generate greater stresses than without. Seismic loads do not have to be considered in conjunction with flood loads.

vi. If a soils report is not available for the site, the prescriptive methods for soil bearing pressures included in the building code can be used with a 10 percent reduction from the capacities provided. Effects of buoyancy shall be included when analyzing soil bearing capacities under flood conditions.

vii. Structures should be designed with a factor of safety of 1.5 and 1.33 for overturning moments and uplift pressures generated by flood waters respectively. Only the dead load shall be included in the calculations.

viii. Uplift pressures are able to be reduced per Section 7.11 to provide a more economical structural design. This can be done by waterproofing membranes along the exterior of the foundation, subsurface foundation drainage, and sumps with pumps.

6. *24 Years of Successful Floodproofing in the Red River Valley of North Dakota and Minnesota* by S. Bruce Langness, Jeff Klein, Mark Bittner, Ron Strand, and Vernon Tomanek (No Date, created post 1997 flood).
    a. The report studied the evolution of the performance of basements in the Red River Valley since the inception of the 1975 Floodproofing Code in Fargo, North Dakota.
    b. The Code in use at the time of the study was the 1995 Floodproofing Code.
    c. The City had just undergone one of the largest floods in the history of the City in 1997, and homes constructed with the 1995 Code sustained no damage (structural or wet basements). The 1997 flood elevations exceeded the 100 year flood elevations by 1.1 to 2.2 feet.
    d. The report states the reasons for the success of the Code as follows:
        i. Reinforced concrete construction
        ii. Low permeability of the soils
        iii. Installation of an interior and exterior drainage system
        iv. Raised elevation of grade around basement
        v. Minimum elevation of basement floor must be less than or equal to 5 feet below base flood elevation
        vi. No openings are allowed below the base flood elevation
    e. Walkout basements were eliminated with the adoption of the 1975 code.
7. U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* (December 15, 1995).
    a. Based on Section S210.2, homes constructed in the Fargo area with basements or partial basements would have a building classification FP2, and the space classification would be W1 or W2 for completely dry and partially dry spaces respectively.
    b. Table 2 in Section 402.0 provides minimum requirements for waterproofing and structural loads. For a space classification of W2 (essentially dry), a structure should have Type B waterproofing and meet Class 1 structural loads.

c. Type B waterproofing "shall be substantially impermeable but may pass water vapor and seep slightly during flooding to the RFD." Seepage water should be less than 4" in depth and be controlled with a sump pump.
d. Class 1 loads include water, impact, and soil loads specified in Chapter 6.
e. Water loads include hydrostatic and hydrodynamic loads. Hydrostatic includes water above and below ground. Hydrodynamic includes loads due to moving water. As per section 602.5, hydrodynamic loads are only required for velocities exceeding 5 feet per second. Hydrostatic loads shall control for velocities below 5 feet per second.
f. Impact loads are described in Section 603.0. Impact loads are to be applied to a structure when "floating debris, ice and any floatable object or mass carried by floodwaters" can strike the building.
g. Structural loads shall be combined based on the applicable building code. Dead, snow and wind loads should be used at full-intensity and live loads can be reduced per the building code. Live loads should only be included when their effects increase the stress on a building component. Seismic loads are not required to act concurrent with flood pressures.
h. If a soils report is not available, the prescriptive methods included in the local building code can be used. The document states the values included in the building code should be reduced, but the reduction amount is omitted.
i. The building shall be designed for a factor of safety of 1.5 against overturning and sliding under flood loads. The building shall also be designed for a factor of safety of 1.33 for buoyancy due to flood loads. Only dead loads should be used as resistance.
j. Uplift pressures can be reduced if waterproofing, foundation drainage, and sumps with pumps are provided.

8. City of Fargo's *Floodproof Construction Requirements* (Updated March 2014)
    a. Document references the Fargo Municipal Code Article 21-06 (Flood Plain Management) and the Floodproofing Code of the City of Fargo, North Dakota (December 9, 1975).
    b. Fill around the basement is required to be +1.2 feet above the 41-foot WSEIA at all openings.
    c. The fill around the building is to be +0.7 feet above the 41-foot WSEIA.
    d. Fill within 15 feet of the building shall be at or above the FEMA BFE.
    e. Details are provided for:
        i. Window Well Detail
        ii. Footing and Foundation Wall Plan
        iii. Typical Wall Section
        iv. Deep Window Well
9. 2014 City of Fargo Code of Ordinances, Chapter 21.1: International Residential Code.
    a. City of Fargo has adopted the *2012 International Residential Code.*

b. Section R404.1.2.1 provides amended reinforcing schedules for foundation walls. Table R404.1.2(10) includes provisions for walls retaining soils with an active pressure of 45 PCF and Table R404.1.2(11) covers walls retaining soils with an active pressure of 65 PCF. Both tables are based on an active soil pressure, which is allowed per the Code. The reinforcing steel has a minimum yield strength of 60,000 psi and the concrete strength is 3,000 psi.
c. Figure R404.1.2(1) and Figure R404.1.2(2) are provided for active pressures of 45 and 65 PCF respectively. The horizontal reinforcing in both figures is shown to be #4 bars spaced at 24" on center. The vertical reinforcing is shown to be located within 1-1/2 and 2-1/2 inches from the inside face of the wall.

Upon review of the documents included above the following conclusions are provided:

1. Since 1975, residential structures have performed well under flooding conditions, including major floods in 1997 and 2009.
2. Current building code requirements (*2014 City of Fargo Code of Ordinances, Chapter 21.1*) for reinforcing for residential basement construction exceed requirements provided in the City of Fargo's *Floodproof Construction Requirements* (March 2014).
3. Homes are currently being constructed with fill around the basement at 1.2 feet above the WSEIA and the FEMA BFE is currently 15 feet away from the home.
4. Both the *Flood Proofing Code of the City of Fargo, North Dakota* and U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314*, have similar structural load requirements. Hydrostatic and hydrodynamic loads should be considered for all structures. However when flood water velocities are below 5 feet per second, only hydrostatic loads need be considered. In addition, impact loads should be considered when buildings or structures can be impacted by debris or other material floating in the flood waters.
5. Methods for reducing uplift on structures are described in both the *Flood Proofing Code of the City of Fargo, North Dakota* and U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* if waterproofing, subsurface drainage and sumps with pumps are provided.
6. Previous calculations did not account for connection at the base slab or top of wall.

Analysis:

A full depth analysis is provided in the design guide presented in Appendix 1.

Conclusions:

Upon completion of our analysis, it was determined the reinforcing recommendations included in Table R404.1.2(11) of the *2014 City of Fargo Code of Ordinances, Chapter 21.1* closely resembled the reinforcing requirements of Case B presented in Appendix 1, but exceed the requirements originally included in the 1975 *Flood Proofing Code of the City of Fargo, North Dakota*. In addition, the connection at the top of the foundation wall for a full height basement was analyzed for the loads included herein, and it was determined that additional anchor bolts, truss clips and

bracing at parallel walls was required to meet the current building codes. Recommendations are also provided to update the waterproofing requirements to reflect current manufacturers and systems.

In conclusion, it is our professional opinion an active equivalent lateral earth pressure of 65 PCF (per Braun Intertec, Corp.) be used as the basis of design for floodproofing basement structures. Tables and figures are provided in Appendix 1 to assist with construction of the wall construction types presented herein. The design provided in this report is only valid when the following conditions are met:

1. Basement shall be constructed as per Exhibit A in the City of Fargo's *Floodproof Construction Requirements* (March 2014).
2. Drain tile or other approved subsurface drainage be provided around interior and exterior basement perimeter and tied into an appropriately sized sump pit with a functioning sump pump.
3. The basement shall be waterproofed with the products included in this report (or approved equivalents).
4. In the event overtopping is eminent or the sump pump fails and is not able to be reinstated in a timely manner, it is recommended the basements be filled with clean water to minimize structural damage as a results of hydrostatic pressure and uplift.

If you have any questions or comments regarding the information included in this report, please contact Cassie McNames at 701-241-2317.

Sincerely,

KLJ

Cassie McNames, PE
Building Services Sector Leader

Enclosure(s): (1) Appendix 1
cc: April Walker, City of Fargo
Travis Wieber, KLJ

Appendix 1: Structural Design Requirements for Floodproofed Basements

Prepared for:

City of Fargo
Engineering
Department
200 3rd Street North
Fargo, ND 58102

Prepared by:

KLJ
728 East Beaton
Drive, Suite 101
West Fargo, ND

November 20, 2014

Structural Design Requirements

Floodproofed Basements in Fargo, ND

Structural Design Requirements

Floodproofed Basements in Fargo, ND

Prepared for:

City of Fargo
Engineering Department
200 3rd Street North
Fargo, ND 58102

Prepared by:

KLJ
728 East Beaton Drive, Suite 101
West Fargo, ND

November 20, 2014

TABLE OF CONTENTS

I. Executive Summary

KLJ and Braun Intertec, Corp. were asked to review the structural requirements of the City of Fargo's existing Floodproofing Code as they relate to current industry practices and design codes. The existing code has performed well under flooding conditions since its inception and has been tested multiple times including major floods of 1997 and 2009. However, the structural requirements have changed very little since it was first created in 1975. The recommendations included herein are based on industry standards and current building code requirements.

II. Analysis

Upon review of documents used to develop previous floodproofing codes, it was determined more information should be gathered related to the soils in the Fargo area and how they affect the structural design requirements for floodproofing basements. Braun Intertec, Corp prepared a geotechnical evaluation for this report which included a seepage analysis and recommendations for lateral earth pressures. Conclusions drawn from the geotechnical evaluation where used to develop the structural design requirements included herein.

A. Seepage Analysis

Braun Intertec, Corp. was asked to perform a seepage analysis on the soils in the Fargo, North Dakota area. The results of their findings are included in Appendix A of this report. A summary of Braun's findings are as follows:

1) Based on discussions with the Fargo-Moorhead Home Builder's Association, foundations on most lots are currently being built on fairly shallow excavations. For the Fargo area, the soils at this depth are a part of the Sherack formation. The fill material brought in to build up the sites is also typically from this formation.

2) The soils in the Sherack formation are typically impervious, but some silt lenses are known to exist. The silt lenses can be troublesome as water can travel through them.

3) Laboratory testing was performed to determine the hydraulic conductivity of the soils in the Fargo area. Hydraulic conductivity is a measurement used to describe the flow of water through the soil. The tests indicate the soils in the Sherack formation have a hydraulic conductivity of 1E-4 foot per day vertically. Observation of local construction projects indicates the horizontal conductivity of 1E-3 foot per day. These numbers indicate is the soils in the Fargo area are impermeable and water does not travel well through the Sherack. It should be noted, however, these values reflect well compacted material, and realistic values for backfill against homes would be "1 to 2 orders of magnitude faster."

4) Groundwater elevations vary throughout the year between five to ten feet below grade. Interviews with local homeowners indicated that bi-level basements (four feet below grade) had sump pumps that ran only during wet seasons and full depth basement sump pumps ran year round.

5) A seepage analysis concluded that basements with a 15 foot setback to the BFE (base flood elevation) would not infiltrate a house foundation for several months for a basement that is nine feet below grade. It was noted that if flood waters were allowed to reach the home during the peak flood the soil could become saturated causing hydrostatic pressures to be of concern. A peak flood was assumed to last "several days to 2 weeks before receding."

B. Lateral Earth Pressures

Braun recommends using an active equivalent fluid pressure of 65 pounds per cubic foot (PCF) per foot depth for soils in the Sherack formation to design basement walls. In order for this assumption to be accurate, the following criteria must be met:

1) Basements should have a flexible diaphragm and adequate subsurface drainage for this assumption to be accurate.

2) A wood floor and subfloor above the basement is considered a flexible diaphragm.

3) Adequate surface drainage must be provided around the perimeter of the home. If silt lenses or sand are found in excavations, the excavations should be over-excavated by at least ten feet horizontally from the basement walls and backfilled with fat clay soils, similar to that of the Sherack formation.

4) If flood water comes in contact with the house or backfill or if the drain tile/sump pump fails, considerations should be made to flood the basement to minimize structural damage due to hydrostatic pressures.

C. Structural Design Requirements

KLJ performed an analysis on basement wall construction for full depth basements and bi-level basements in Fargo based on the design parameters provided by Braun Intertec and design requirements detailed in the U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314*. A summary of the analysis is included in the following sections.

DESIGN CODES:

Analysis of basement wall construction shall comply with the following building codes:

1) 2012 International Building Code (2012 IBC)

2) 2012 International Residential Code (2012 IRC)

3) American Concrete Institute 318-11: Building Code and Commentary (ACI 318-11)

4) 2012 National Design Specification (2012 NDS) for Wood Construction

STRUCTURAL LOADS:

1) Hydrostatic loads on the structure need not be considered with a 15 foot setback to the BFE. Under these conditions, Braun's seepage analysis determined it would take several months to saturate the soil adjacent to the basement walls. Given that peak floods only last about two weeks and homes are being constructed with a subsurface drainage system, the probability is very low that flood waters would reach foundation walls.

2) Hydrodynamic loads on the structure do not need to be considered. As per the *Flood Insurance Study* booklet prepared by FEMA for Cass County, North Dakota (effective January 16, 2015), the mean velocity of the Red River varies between 0.8 and 2.5 feet per second. The U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* states hydrodynamic loads need only be considered with velocities of five feet per second or greater.

3) Impact loads do not need to be considered as the probability that flood water elevations would exceed the ground elevation adjacent to the structure would be minimal.

4) Buoyancy is not a concern with flood and groundwater levels being maintained below the basement slab with a subsurface drainage system.

5) Basement walls and their connections shall be designed using an active equivalent lateral earth pressure of 65 PCF.

ANALYSIS:

KLJ completed a structural analysis on full height, bi-level, and window well basement walls using the design codes and loads listed above. Tables and figures associated with the analysis are provided in Appendix B. A summary of the design procedure used to develop each table and figure is as follows:

1) Full height basement walls:

   a) Two reinforcing options are provided in Tables 1A and 1B.

      i) Case A includes provisions for 2-way slab action in the concrete walls to minimize the connection requirements at the top of the wall.

      ii) Case B also accounts for 2-way action in the concrete walls and allows for maximum spacing between walls perpendicular (i.e. jogs) to the foundation wall. Minimum reinforcing is based on the worst case between temperature and shrinkage steel or steel required to achieve moment capacity.

      iii) A detail of the reinforcing requirements is provided in Figure 1.

2) Bi-level basement design was based on a cantilevered concrete foundation wall. Reinforcing requirements are provided in Table 2 and a detail of the wall construction is provided in Figure 2.

3) Window well walls were designed to span horizontally. Reinforcing requirements are included in Table 3. A detail of the wall construction is provided in Figure 3.

D. Waterproofing

Waterproofing is required on the exterior surface of all basement walls and below basement slabs. Waterproofing shall be continuous from the top of the soil to the bottom of the footing. Recommendations for waterproofing materials are provided below.

1) Foundation wall: Fluid-applied or sheet-applied waterproofing methods may be utilized. The exterior surface of the foundation wall, top of footing and side of footing. Foundation waterproofing shall consist of a fluid-applied waterproofing membrane, with a minimum thickness of 60 wet mils of "CCW-703 Liquiseal" or a sheet applied waterproofing membrane, self-adhering for vertical and horizontal applications

of either “MiraDRI 860” for warm temperature installations or “MiraDRI 861” for colder temperature applications. Similar products may be used as an approved equal.

2) Under slab: Under slab waterproofing shall consist of a 55 mil, horizontal grade “MiraPLY-H” membrane. “Liquiseal”, “MiraDRI”, and “MiraPLY-H” waterproof membrane products are manufactured by Carlisle Coatings & Waterproofing of Wylie, Texas. Similar products may be used as an approved equal.

III. Conclusions

An active equivalent lateral earth pressure of 65 PCF shall be used as the basis of design for floodproofing basement structures. Tables and figures are provided in Appendix B to assist with construction of the wall construction types presented herein. The following conditions must be met to comply with the design recommendations included in this report.

1) Basement shall be constructed as per Exhibit A in the City of Fargo’s *Floodproof Construction Requirements*.

2) Drain tile or other approved subsurface drainage be provided around interior and exterior basement perimeter and tied into an appropriately sized sump pit with a functioning sump pump.

3) The basement shall be waterproofed with the products included in this report (or approved equivalents).

4) In the event overtopping is eminent or the sump pump fails and is not able to be reinstated in a timely manner, it is recommended the basements be filled with clean water to minimize structural damage as a result of hydrostatic pressure and uplift.

Appendix A

Geotechnical Reports

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
526 10th Street NE, Suite 300
P.O. Box 485
West Fargo, ND 58078

Phone: 701.232.8701
Fax: 701.232.7817
Web: braunintertec.com

November 6, 2014 Project B14-07345

Cassie McNames, PE
KLJ, Inc.
728 East Beaton Drive, Suite 101
West Fargo, North Dakota 58078

Re: DRAFT Geotechnical Evaluation Letter
City of Fargo Project #MS-14-71
Floodproof Basement Structural Review
Fargo, North Dakota

Dear Ms. McNames:

This Geotechnical Evaluation Letter addresses geotechnical aspects of the City of Fargo's Floodproof Basement Structural Review.

Background

We understand the original design of the City of Fargo's floodproof basement was completed in 1975 and at that time the City was able to receive a basement exception from FEMA. As part of the current FEMA floodplain remapping process, the City is required to renew their basement exception with FEMA. As part of this renewal we understand KLJ is assisting the City with a structural analysis of the standard basement wall detail. The City requested that you engage a geotechnical engineer to provide recommendations for soil parameters to be used in design of the wall as well as a seepage analysis to estimate the timeframe for full saturation of soil adjacent a basement wall.

Information Reviewed

In preparation of this letter, we reviewed a number of documents and resources. These documents and resources are listed below along with some of the key takeaways we considered from each.

- August 27, 1974 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Soil Pressures in the Fargo-Moorhead Area.
    - Design walls to withstand an equivalent fluid pressure of 120 pcf.
    - Install a drain tile system at the perimeter and below the floor to control uplift.
    - Backfill utility connection trenches with well compacted clayey soil to prevent easy flow nets for infiltrating water.
    - All sites should be checked by a knowledgeable individual to determine that there is not an unusual uniform silt condition present or pervious fill.
- February 24, 1975 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Basement Soil Pressures in the Fargo-Moorhead Area.
    - Ulteig and SEC discussed several homes that were completely surrounded by floodwater for 2 weeks (although overland flow did not reach the basement walls). The homes were

not designed for a maximum soil pressure [120 pcf] and the basement walls were not affected by horizontal soil pressure.
    - A design of less than the maximum soil pressure should provide for construction detail that will insure the maximum stress will not occur.
    - A lesser design soil pressure value was not stated, but it was stated that a "solution within reasonable economic means can be obtained" if freestanding water will not be adjacent the walls, surrounding soils are cohesive and relatively impervious, a drain tile system is in place to collect seepage, easy flow channels to the structure be prevented, utility trenches should be backfilled with cohesive soils and well compacted, gravel fill under driveways and so forth should be kept above flood levels, adequate surface drainage must be maintained away from the structure, and down spouts and local runoff cannot allow ponding adjacent walls.
    - The homeowner should be informed that his basement is not designed to withstand full hydrostatic pressure and he should understand the necessity of maintaining the drain tile system and that if the system fails or if flood waters make approximate contact with the basement walls, the basement should be flooded.
- City of Fargo Code of Ordinances, Article 21-0102, Section 1610.1
    - Exception to International Building Code: Foundation walls extending not more than 9 feet below grade and laterally supported at the top by flexible diaphragms shall be permitted to be designed for active pressure.
- Home Builders Association meeting on October 15, 2014
    - Currently on LOMR lots, excavations to bottom of foundation level are typically about 1 to 3 feet below natural ground and the remainder of the pad is built up from there.

Discussion

Soils

The soils in the City of Fargo were deposited by Glacial Lake Agassiz and are rather consistent across the City. The soils within the typical basement depth of not more than 9 feet consist of what is known as the Sherack formation. As they exist in the upper 9 feet, materials from this formation are most often used as basement wall backfill and from our experience they are also most often used as fill on LOMR lots.

The Sherack formation consists of fat clay that is rather impervious, but is sometimes stratified with silt or sand seams and layers that will increase its hydraulic conductivity. The Sherack formation most often weighs about 115 pcf in its normal, wet condition. Numerous shear strength tests we have performed on material from the Sherack formation indicate that if well compacted it will have a typical internal friction angle of about 25 degrees. Since house pad excavations are relatively small in size, they limit the size of compaction equipment and the overall effectiveness of compaction effort. To account for this we have assumed the internal friction angle for wall design of about 2/3 this value, or 16 degrees. This assumption should not relieve the contractor from the need for compaction of the backfill.

The conductivity of the Sherack formation averages approximately 1E-4 ft/day vertically (as determined from our laboratory testing) and 1E-3 ft/day horizontally (as determined through the in-situ monitoring of pore water pressure dissipation on local embankment construction projects). The conductivity of backfill is highly variable and dependent on material type, placement and level of compaction. Well

compacted backfill would likely have conductivity values similar to those stated for the Sherack formation, while poorly compacted backfill is likely 1 to 2 orders of magnitude faster.

Groundwater

Measured groundwater depths typically vary across the City with location and season, but we have found that most often groundwater is encountered within about 5 to 10 feet of the ground surface seasonally. With regards to sump pump operation, we interviewed 12 homeowners across the City with variability in location, age of home, and depth of basement. The responses were very consistent in that homeowners with split level structures, or 4-foot deep basements, had sump pumps that ran only during rainy periods and homeowners with full basements had sump pumps that ran outside of rainy periods and several stated year round. These interview results would support the groundwater measurements we have observed within 5 to 10 feet of the ground surface.

Analysis

We performed a seepage analysis using a finite element program called SEEP/W from GeoStudio. The analysis was performed for a home with soil conditions typical of the Fargo area. We assumed that the basement is 9 feet below the ground surface and that flood waters would not be closer than 15 feet from the basement wall. The 15-foot distance was selected as it is typically greater than the excavation width for a basement wall and it is also currently the requirement by the City of Fargo for the minimum distance from the BFE for flood proofing construction.

The analysis indicates that the flood waters would have to be in place for several months for water to infiltrate to the house foundation or even the normal backfill wedge against a house. Peak flood conditions in this area typically last several days to as much as about 2 weeks before receding. It should be noted that if flood water contacted a basement wall and covered the wall backfill, saturation of the backfill could occur within the normal timeframe of peak flood conditions.

Recommendations

For design of basement walls we recommend using an active equivalent fluid pressure of 65 pcf per foot of depth (this value does not include a factor of safety). This value assumes the soil conditions noted in the *Discussion* above, and that the wall has a flexible diaphragm, and also assumes that the house has a functioning drain tile system. Many basements are constructed above the groundwater, but even those that are below the groundwater (estimated at 1 to 2 feet maximum seasonally) can experience drawdown of the groundwater below the active pressure zone on the wall if a properly functioning drain tile system is in place.

To use this value we further recommend that grades within 10 feet horizontal of the perimeter of the house should be sloped down and away from the structure at a minimum gradient of 5 percent to prevent ponding, and all roof run-off should be collected by gutters and routed to drains with long downspouts, which are diverted to areas more than 5 to 10 feet from the structure.

If basement excavations encounter layers of sand or silt, the excavations should be constructed so that they extend at least 10 feet away from the basement walls, and the entire excavation should be

backfilled with fat clay soils typical of the area to lessen seepage through the sand/silt layer towards the structure.

As noted by Soil Engineering Company, we agree that if flood water comes in contact with the house or wall backfill, or if the drain tile system fails during periods of flooding, the homeowner should consider flooding the basement to limit structural damage to the basement wall.

Remarks

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions about this Letter, please contact Nate McKinney or Sean Swartz at 701.232.8701.

Sincerely,

BRAUN INTERTEC CORPORATION

Sean S. Swartz, PE
Principal Engineer

Professional Certification:
I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of North Dakota.

Nathan L. McKinney, PE
Principal – Senior Engineer
Registration Number: PE-6735
November 6, 2014

Appendix B

Tables and Figures

Table 1A: Minimum Reinforcement Requirements for Floodproofed Basement Walls - Full Height Walls (65 PCF)

Wall Height (ft)	Case	Wall Thickness (in)	Vertical Reinforcing	Horizontal Reinforcing	Maximum Horizontal Distance between Perpendicular Foundation Walls (ft)	Dowel Spacing (ft)
7.5	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c.	7.5	4'-0" o.c.
				# 5 @ 28 " o.c.		
				# 6 @ 40 " o.c.		
		10		# 4 @ 12 " o.c.		
				# 5 @ 18 " o.c.		
				# 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c.		
				# 5 @ 15 " o.c.		
				# 6 @ 21 " o.c.		
	B	8	# 4 @ 22 " o.c.	# 4 @ 24 " o.c.	15	1'-10" o.c.
			# 5 @ 30 " o.c.			
			# 6 @ 44 " o.c.			
		10	# 4 @ 24 " o.c.			
			# 5 @ 36 " o.c.			
			# 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c.			
			# 5 @ 28 " o.c.			
			# 6 @ 38 " o.c.			
8	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c.	8	2'-0" o.c.
				# 5 @ 28 " o.c.		
				# 6 @ 40 " o.c.		
		10		# 4 @ 12 " o.c.		
				# 5 @ 18 " o.c.		
				# 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c.		
				# 5 @ 15 " o.c.		
				# 6 @ 21 " o.c.		
	B	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	16	1'-6" o.c.
			# 5 @ 26 " o.c.			
			# 6 @ 40 " o.c.			
		10	# 4 @ 24 " o.c.			
			# 5 @ 36 " o.c.			
			# 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c.			
			# 5 @ 28 " o.c.			
			# 6 @ 38 " o.c.			
9	A	8	# 4 @ 24 " o.c.	# 4 @ 14 " o.c.	9	2'-0" o.c.
				# 5 @ 22 " o.c.		
				# 6 @ 28 " o.c.		
		10		# 4 @ 12 " o.c.		
				# 5 @ 18 " o.c.		
				# 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c.		
				# 5 @ 15 " o.c.		
				# 6 @ 21 " o.c.		
	B	8	# 4 @ 12 " o.c.	# 4 @ 24 " o.c.	18	1'-0" o.c.
			# 5 @ 18 " o.c.			
			# 6 @ 26 " o.c.			
		10	# 4 @ 16 " o.c.			
			# 5 @ 24 " o.c.			
			# 6 @ 36 " o.c.			
		12	# 4 @ 18 " o.c.			
			# 5 @ 28 " o.c.			
			# 6 @ 38 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the inside face of the wall
4. Minimum concrete stregnth,f_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Minimum length of perpendicular wall or "jog" shall be 2 feet. Perpendicular wall shall be reinforced with same reinforcing as wall it supports.
8. Refer to Table 1B for connection requirements at the top of the wall
9. Refer to Figure 1 for basement wall detail.

Table 1B: Minimum Connection Requirements for Floodproofed Basement Walls - Full Height Walls (65 PCF)

Wall Height (ft)	Case	Sil Plate	Optional Top Plate Nailing Pattern	Anchor Bolt	Connection @ Truss	Bracing @ Walls Parallel to Trusses	
						Max. Spacing	Conn. to Sill PL
7.5	A	2-2x	16d @ 6 " o.c.	1/2" ϕ @ 20 " o.c.	A34 @ ea. Truss	4'-6"	2-A35 Clips
				5/8" ϕ @ 26 " o.c.			
				3/4" ϕ @ 32 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 8 " o.c.	2-A35 @ ea. Truss	2'-3"	2-A35 Clips
				5/8" ϕ @ 10 " o.c.			
				3/4" ϕ @ 12 " o.c.			
8	A	2-2x	16d @ 5 " o.c.	1/2" ϕ @ 18 " o.c.	A35 @ ea. Truss	4'-0"	2-A35 Clips
				5/8" ϕ @ 24 " o.c.			
				3/4" ϕ @ 30 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 9 " o.c.	2-A35 @ ea. Truss	2'-0"	2-A35 Clips
				5/8" ϕ @ 12 " o.c.			
				3/4" ϕ @ 15 " o.c.			
9	A	2-2x	16d @ 4 " o.c.	1/2" ϕ @ 14 " o.c.	A35 @ ea. Truss	3'-0"	2-A35 Clips
				5/8" ϕ @ 18 " o.c.			
				3/4" ϕ @ 22 " o.c.			
	B	2-2x	16d @ 2 " o.c.	1/2" ϕ @ 11 " o.c.	2-A35 @ ea. Truss	1'-6"	2-A35 Clips
				5/8" ϕ @ 14 " o.c.			
				3/4" ϕ @ 18 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Anchor bolts shall be ASTM F1554 Grade 36.
3. Minimum clear distance between bolt and edge of concrete shall be no less than 2 inches.
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Refer to Table 1A for reinforcing requirements.
8. Refer to Figure 1 for basement wall detail.

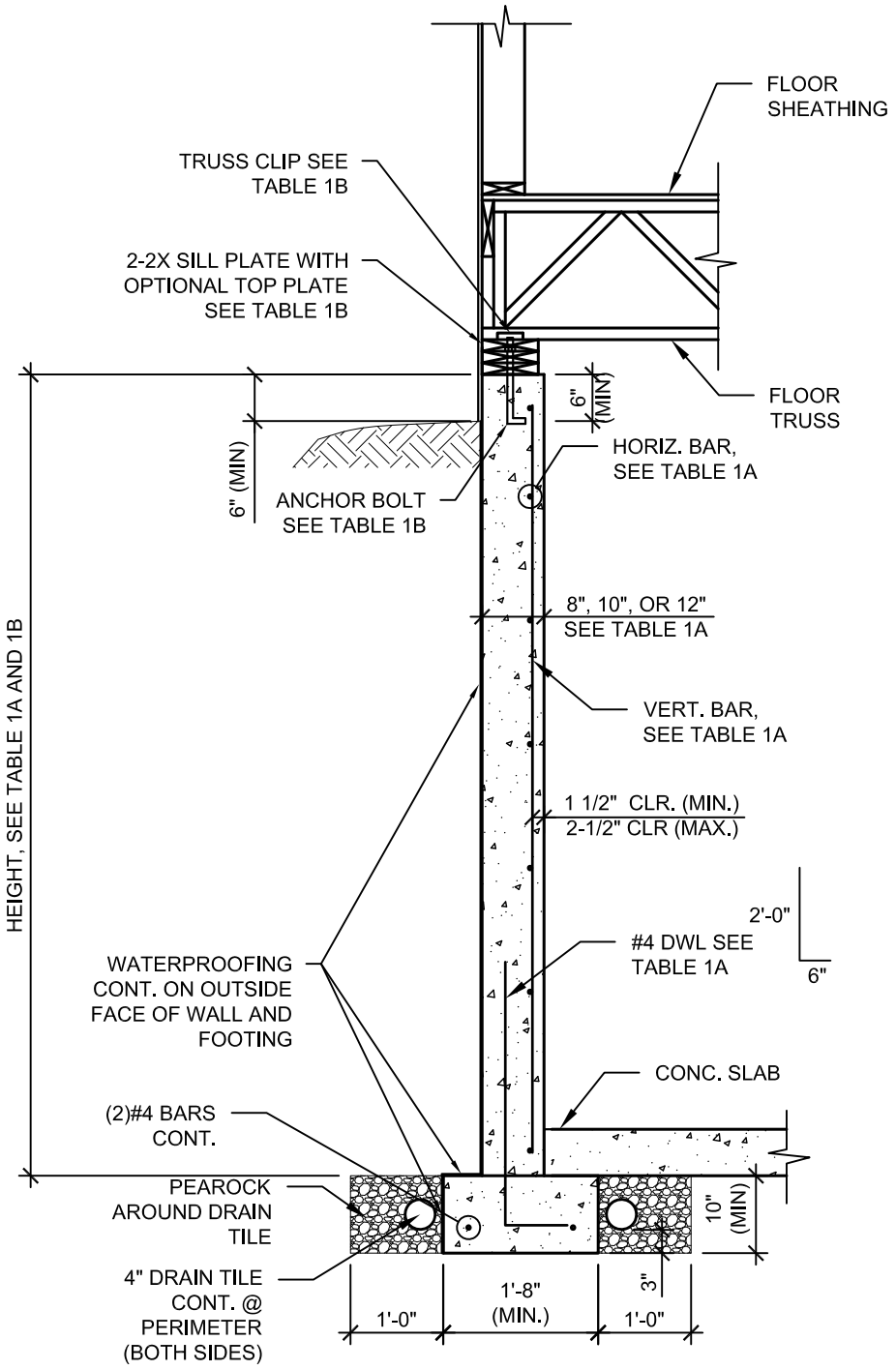

FIGURE 1: BASEMENT WALL SECTION

PRELIMINARY, NOT FOR CONSTRUCTION

Table 2: Minimum Reinforcement for Floodproofed Basement Walls - Bi-Level Walls (65 PCF)

Wall Height ft	Wall Thickness in	Vertical Reinforcing	Horizontal Reinforcing
5 (max)	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.
		# 5 @ 30 " o.c.	
		# 6 @ 40 " o.c.	
	10	# 4 @ 18 " o.c.	
		# 5 @ 26 " o.c.	
		# 6 @ 36 " o.c.	
	12	# 4 @ 12 " o.c.	
		# 5 @ 20 " o.c.	
		# 6 @ 28 " o.c.	

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the outside face of the wall.
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 2 for basement wall detail.

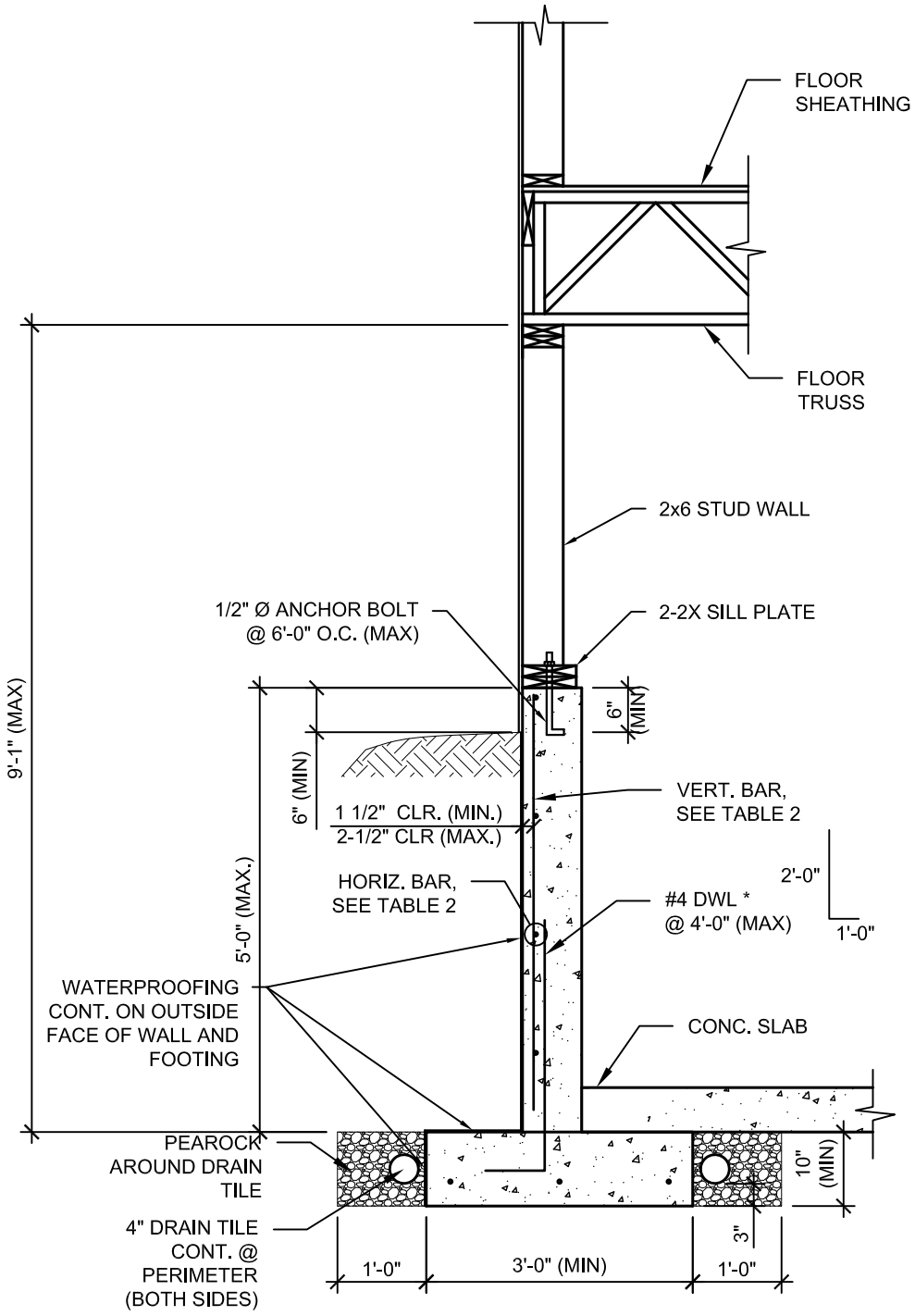

FIGURE 2: BI-LEVEL BASEMENT WALL SECTION

*NOTE: CONTRACTIORS OPTION TO SUPPLY VERTICAL REINF. WITH 1'-0" HOOK INTO FOOTING AND OMIT DOWEL BAR.

PRELIMINARY, NOT FOR CONSTRUCTION

Table 3: Minimum Reinforcement for Floodproofed Basement Walls - Window Well Walls (65 PCF)

Wall Height (ft)	Wall Thickness (in)	Horizontal Reinforcing	Vertical Reinforcing	Max. Horizontal Span (ft)
7.5	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0'
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0'
		# 4 @ 12 " o.c.		7'-6"
		# 4 @ 9 " o.c.		10'-0"
8	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0'
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0'
		# 4 @ 12 " o.c.		7'-0"
		# 4 @ 9 " o.c.		9'-6"
9	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	3'-6"
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-0"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	5'-6"
		# 4 @ 12 " o.c.		6'-6"
		# 4 @ 9 " o.c.		9'-0"

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_v, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between an 1-1/2 and 2-1/2 inches from the inside face of the wall.
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 3 for basement wall detail.

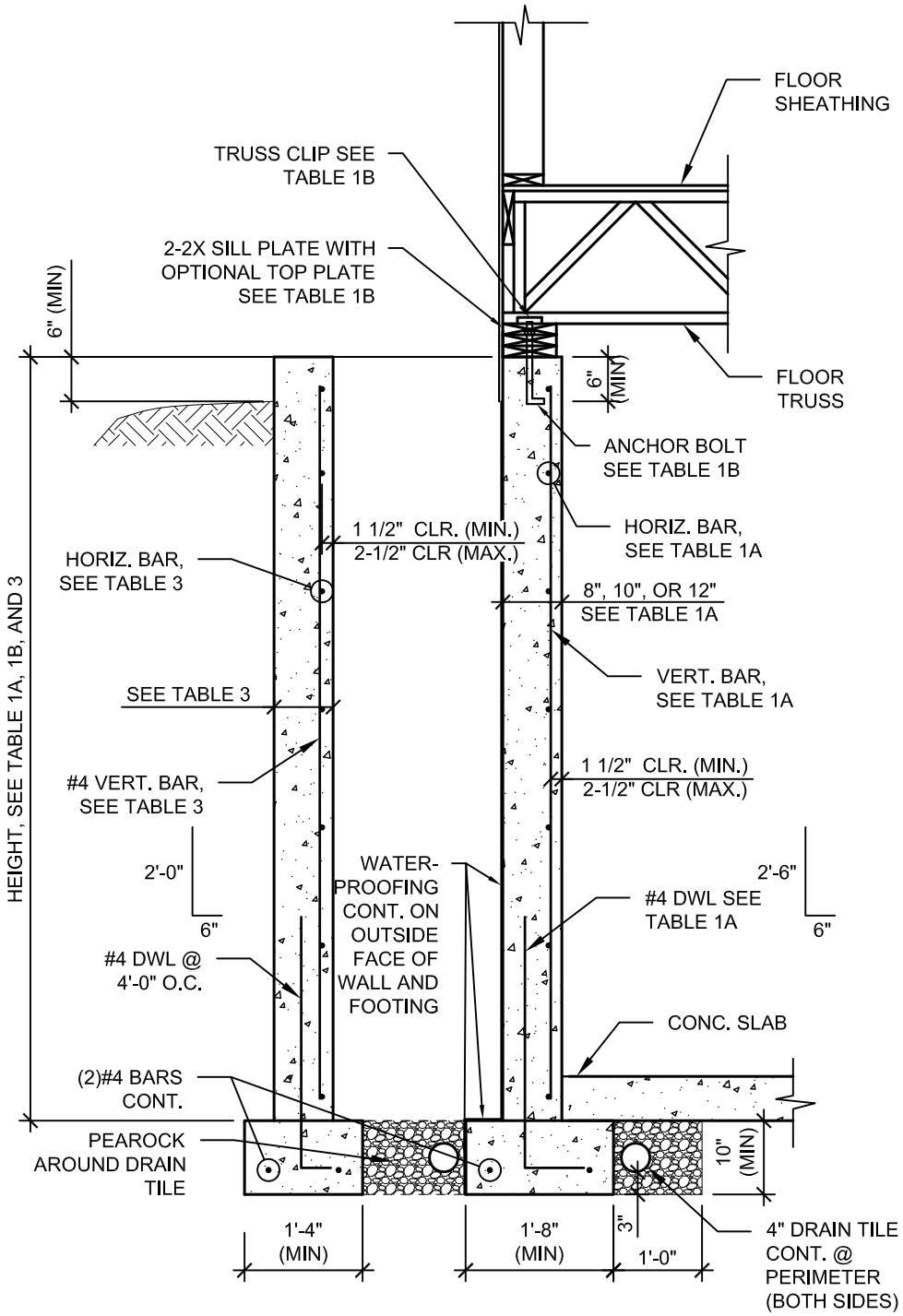

FIGURE 3: WINDOW WELL SECTION

PRELIMINARY, NOT FOR CONSTRUCTION

APPENDIX H

FARGO-MOORHEAD HOME BUILDERS ASSOCIATION AFFORDABILITY REPORT

Home Builders Association of Fargo-Moorhead

1802 32nd Avenue South · Fargo, ND 58103 · (701) 232-5846 · Fax (701) 280-1108
info@hbafm.com · www.hbafm.com

November 13, 2014

Ryan Pietramali
Chief of Risk Analysis Branch
Federal Emergency Management Agency
Denver Federal Center
Building 710, Box 25267
Denver, CO 80225-0267

Mr. Pietramali:

The City of Fargo has graciously been granted the basement exception for nearly 40 years. During this time, area builders have been building floodproof basements according to the City's floodproofing code and policies with basement depths ranging between 7.5-feet and 9-feet. During these 40 years of constructing floodproof basements, there have been no documented failures even though our region experienced a flood of record and multiple other near record floods. In our region, we follow different building practices due to several environmental considerations including climate, soil and topography. In Fargo, the basement is not only a living area, but protects residents from severe weather including tornados.

The Home Builders Association of Fargo-Moorhead promotes home ownership on all price levels, especially for people building their first home and contractors constructing affordable housing. A FEMA mandate requiring local builders to maintain a 5-foot differential between the base flood elevation and the top of the basement floor would result in significant financial impacts, effectively pricing buyers out of their home.

According to a study of the Fargo metropolitan statistical area completed by the National Association of Home Builders this year, a $1,000 increase in price results in about 195 households no longer being able to afford that home.

Two costs would increase when factoring in raising the basement floor: the lot price and construction costs. Lots would require 1 foot of additional fill, adding $17,500 to their price. Additional construction costs vary from $10.25-$12 per square foot depending on the size of the foundation.

- For an entry-level or starter home, often built by a first-time home buyer in the $280,000 price range, the additional cost would be $29,500 (a 10.5-percent increase). This is an extra $12,000 in construction costs and $17,500 for the lot.
- For a mid-level home in the $350,000 price range, the additional cost would be $35,500 (a 10.1-percent increase). This is an extra $17,000 for construction costs and $17,500 for the lot.
- For a high-end home in the $500,000 price range, the additional costs would be $42,500 (an 8.5-percent increase). This is an extra $25,000 in construction costs and $17,500 for the lot.

The financial impacts, ranging from an additional 8.5 to 10.5 percent of the current costs would be detrimental not only to the home building industry, but would discourage first-time home buyers from investing in the community, leading to even greater economic ramifications. Consider the entry-entry level example: a $29,500 increase would "price out" over 5,700 households from buying in the Fargo market.

The HBA of F-M respectfully encourages FEMA to allow the city of Fargo to continue building floodproof basements to their current standards and not to the 5-foot differential from the base flood elevation to the top of the basement floor. Thank you for your consideration when reviewing the renewal of the basement exception for the City of Fargo.

Sincerely,

Bryce Johnson

Carlita Dietz

Bryce Johnson
Executive Vice President

Carlita Dietz
President

APPENDIX I

SOLICATION OF VIEWS LETER,

MAILING LIST &

RECEIVED RESPONSES

ND Department of Emergency Services

NDDES Homeland Security State Radio

PO Box 5511
Bismarck, ND 58506-5511

Tel: (701) 328-8100
Fax: (701) 328-8181

Email: nddes@nd.gov
Website: www.nd.gov/des

Ensuring a safe and secure homeland for all North Dakotans

October 7, 2014

City of Fargo Engineering Department
Attn: Nathan Boerboom
200 3rd Street North
Fargo ND 58104

RE: Solicitation of Views on City of Fargo's Basement Exception

Dear Mr. Boerboom:

Thank you for your letter dated September 19, 2014 requesting comments on all social, economic and environmental effects on the continuance of the City's basement exception from FEMA once the new FIS study is adopted in January.

The North Dakota Department of Emergency Services, Division of Homeland Security agrees basement construction is an efficient design for our climate. Further, this policy and your flood plain management procedures are an appropriate method for planning for and mitigating against potential future damages.

Should you have any additional questions, please contact me at 701-328-8256.

Sincerely,

Cody Schulz
Disaster Recovery Chief
ND Department of Emergency Services
Division of Homeland Security

Enclosure: Request Letter

CITY OF Fargo

ENGINEERING DEPARTMENT
200 3rd Street North
Fargo, North Dakota 58102
Phone: (701) 241-1545
Fax: (701) 241-8101
E-Mail: feng@cityoffargo.com

September 19, 2014

Lonnie Hoffer
Disaster Recovery Chief
ND Department of Emergency Services
PO Box 5511
Bismarck, ND 58506

Re: Solicitation of Views on City of Fargo's Basement Exception

Dear Lonnie Hoffer:

The Federal Emergency Management Agency (FEMA) is in the process of finalizing a revision to the Flood Insurance Study (FIS) within the City of Fargo, ND. Once the new FIS is adopted, which is anticipated to be January 16, 2015, the City of Fargo will have additional land located in Special Flood Hazard Areas (SFHA) that will now be required to follow the City of Fargo's floodplain management requirements for any construction activity. One of these requirements that the City has had in place since the mid-1970's was the requirement for any basement construction located within the SFHA to be constructed per the City's floodproofing code, which was developed and approved by FEMA in 1975. FEMA allows these basements to be constructed in the SFHA since the City is one of the National Flood Insurance Program (NFIP) participating communities that have received a basement exception.

The purpose of this letter is to solicit views on all social, economic and environmental effects on the continuance of the City's basement exception from FEMA once the new FIS study is adopted in January. The City is required to renew its basement exception status as part of the adoption process of the new FIS. The City desires to continue this exception. Basement construction is an efficient design for our climate which requires that footings for any structure be constructed below any possible frost depth, which can easily exceed four-feet on any given winter. The excavation required for footing construction at this depth (six to eight feet) is essentially the same as if a basement was going to be constructed. So for economic reasons the decision to construct a basement is the most logical for property owners since the land disturbance under each scenario would be the same. With the added provisions in our floodproofing code we have effectively avoided flood damages in basements further reinforcing their efficiency. Also our City is located in a region that has a risk to being impacted with tornados and providing this important storm shelter is a critical function of the lower level of homes in our region.

If the basement exception is not continued within the City, it will not prevent further development from occurring within the City, but instead will change the standard construction method to a slab on grade construction, which as I previously discussed will result in the same disturbance as standard basement construction due to the footing depth requirements. These areas within the City that could potentially experience future development are today being used for agriculture row crops and have been so for decades prior to any possible development. The City has procedures in place for any new proposed developed to follow its floodplain management procedures. Part of these procedures require that any land that is located within the SFHA to be elevated above the 1% annual chance floodplain (base flood elevation) as well as have the lowest opening of a structure elevated at least 1.2-feet above the 41-feet river gage elevation (new FEMA FIS base flood elevation is a river gage elevation of 39.4-feet).

Please forward any comments or information you may have to our office on or before October, 17, 2014. If we do not receive a reply from your office by this date, we will assume that you have no comments on the continuance of the basement exception with the City of Fargo, ND.

Please forward any comments or information you may have to:

City of Fargo Engineering Department
Attn: Nathan Boerboom
200 3rd Street North
Fargo, ND 58104

If you have any questions or would like more information on the basement exception process, please call myself, Nathan Boerboom, at (701) 476-6743. Thank you ahead of time for your assistance in this process.

Sincerely,

Nathan Boerboom, PE, CFM

C: April Walker, City of Fargo City Engineer

STATE HISTORICAL SOCIETY OF NORTH DAKOTA

October 6, 2014

City of Fargo Engineering Department
Attn Nathan Boerboom
200 3rd Street North
Fargo, ND 58104

ND SHPO Ref.: 15-5026, City of Fargo's Basement Exception, Fargo, Cass County, North Dakota

Dear Mr. Boerboom,

We reviewed ND SHPO Ref.: 15-5026, City of Fargo's Basement Exception, Fargo, Cass County, North Dakota and if consulted by a federal agency we would concur with the determination of "No Historic Properties Affected" for the continuation of the basement exception in the City of Fargo.

Thank you for the opportunity to review this project. If you have any questions please contact Lisa Steckler, Preservation Planner at (701) 328-3577, e-mail lsteckler@nd.gov

Sincerely,

Merlan E. Paaverud, Jr.
State Historic Preservation Officer
(North Dakota)

CASS COUNTY
GOVERNMENT

Highway Department

Jason Benson, P.E.
County Engineer

Richard S. Sieg
Superintendent

Thomas B. Soucy, P.E.
Design and Construction Engineer

October 6, 2014

City of Fargo
Nathan Boerboom, PC, CFM
200 3rd Street N
Fargo, ND 58102

RE: Solicitation of views on City of Fargo's Basement Exception

Dear Nathan,

In response to your solicitation for views on continuing the City of Fargo's basement exemption, the County supports the floodproof construction requirements for basements as per the City of Fargo and realizes that economic burdens may be placed on homeowners if the exemption is not continued.

Floodproofed basements have been shown to reduce or eliminate structural damage, provide safety during inclement weather, provide added living space, and reduce the costs of flood insurance.

Considering the communities granted basement exceptions by FEMA and proof that no damage has been incurred to the basements built in accordance with the community floodplain management ordinance, the County sees the importance of continuing this exemption.

Respectfully,

Hali A Durand
County Planner

1201 Main Avenue West
West Fargo, North Dakota
58078-1301

701-298-2370
Fax: 701-298-2395

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
NORTH DAKOTA REGULATORY OFFICE
1513 SOUTH 12TH STREET
BISMARCK ND 58504-6640

REPLY TO
ATTENTION OF

September 24, 2014

North Dakota Regulatory Office

Mr. Nathan Boerboom
City of Fargo
200 3rd Street North
Fargo, North Dakota 58102

Dear Mr. Boerboom:

This is in response to your letter dated September 19, 2014, requesting US Army Corps of Engineers (Corps) comments regarding the proposed Federal Emergency Management Agency's Flood Insurance Study within Fargo, North Dakota.

Corps regulatory offices administer Section 10 of the Rivers and Harbors Act (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 regulates work impacting navigable waters. Section 10 waters in North Dakota are the Missouri River (including Lake Sakakawea and Lake Oahe), Yellowstone River, James River south of the railroad track in Jamestown, North Dakota, Bois de Sioux River, Red River of the North, and the Upper Des Lacs Lake. Work over, in, or under navigable waters is considered to have an impact. Section 404 of the Clean Water Act regulates the discharge of dredged or fill material (temporarily or permanently) in waters of the United States. Waters of the United States may include, but are not limited to, rivers, streams, ditches, coulees, lakes, ponds, and their adjacent wetlands. Fill material includes, but is not limited to, rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from mines or other excavation activities and materials used to create any structure or infrastructure in waters of the United States.

If you believe a Corps permit will be required, please complete the enclosed application and submit it to the letterhead address.

Do not hesitate to contact this office by letter or telephone (701) 255-0015, if we can be of further assistance.

Sincerely,

Daniel E. Cimarosti
Regulatory Program Manager
North Dakota

Enclosure

Instructions for Preparing a
Department of the Army Permit Application

Blocks 1 through 4. To be completed by Corps of Engineers.

Block 5. Applicant's Name. Enter the name and the E-mail address of the responsible party or parties. If the responsible party is an agency, company, corporation, or other organization, indicate the name of the organization and responsible officer and title. If more than one party is associated with the application, please attach a sheet with the necessary information marked Block 5.

Block 6. Address of Applicant. Please provide the full address of the party or parties responsible for the application. If more space is needed, attach an extra sheet of paper marked Block 6.

Block 7. Applicant Telephone Number(s). Please provide the number where you can usually be reached during normal business hours.

Blocks 8 through 11. To be completed, if you choose to have an agent.

Block 8. Authorized Agent's Name and Title. Indicate name of individual or agency, designated by you, to represent you in this process. An agent can be an attorney, builder, contractor, engineer, or any other person or organization. Note: An agent is not required.

Blocks 9 and 10. Agent's Address and Telephone Number. Please provide the complete mailing address of the agent, along with the telephone number where he / she can be reached during normal business hours.

Block 11. Statement of Authorization. To be completed by applicant, if an agent is to be employed.

Block 12. Proposed Project Name or Title. Please provide name identifying the proposed project, e.g., Landmark Plaza, Burned Hills Subdivision, or Edsall Commercial Center.

Block 13. Name of Waterbody. Please provide the name of any stream, lake, marsh, or other waterway to be directly impacted by the activity. If it is a minor (no name) stream, identify the waterbody the minor stream enters.

Block 14. Proposed Project Street Address. If the proposed project is located at a site having a street address (not a box number), please enter it here.

Block 15. Location of Proposed Project. Enter the latitude and longitude of where the proposed project is located. If more space is required, please attach a sheet with the necessary information marked Block 15.

Block 16. Other Location Descriptions. If available, provide the Tax Parcel Identification number of the site, Section, Township, and Range of the site (if known), and / or local Municipality that the site is located in.

Block 17. Directions to the Site. Provide directions to the site from a known location or landmark. Include highway and street numbers as well as names. Also provide distances from known locations and any other information that would assist in locating the site. You may also provide description of the proposed project location, such as lot numbers, tract numbers, or you may choose to locate the proposed project site from a known point (such as the right descending bank of Smith Creek, one mile downstream from the Highway 14 bridge). If a large river or stream, include the river mile of the proposed project site if known

Block 18. Nature of Activity. Describe the overall activity or project. Give appropriate dimensions of structures such as wing walls, dikes (identify the materials to be used in construction, as well as the methods by which the work is to be done), or excavations (length, width, and height). Indicate whether discharge of dredged or fill material is involved. Also, identify any structure to be constructed on a fill, piles, or float-supported platforms.

The written descriptions and illustrations are an important part of the application. Please describe, in detail, what you wish to do. If more space is needed, attach an extra sheet of paper marked Block 18.

Block 19. Proposed Project Purpose. Describe the purpose and need for the proposed project. What will it be used for and why? Also include a brief description of any related activities to be developed as the result of the proposed project. Give the approximate dates you plan to both begin and complete all work.

U.S. ARMY CORPS OF ENGINEERS

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

Form Approved - OMB No. 0710-0003 Expires: 31-AUGUST-2013

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Middle - Last -	First - Middle - Last -
Company -	Company -
E-mail Address -	E-mail Address -
6. APPLICANT'S ADDRESS:	9. AGENT'S ADDRESS:
Address-	Address-
City - State - Zip - Country -	City - State - Zip - Country -
7. APPLICANT'S PHONE NOs. w/AREA CODE	10. AGENTS PHONE NOs. w/AREA CODE
a. Residence b. Business c. Fax	a. Residence b. Business c. Fax

STATEMENT OF AUTHORIZATION

11. I hereby authorize, _____ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

_____ _____

SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
	Address
15. LOCATION OF PROJECT	City - State- Zip-
Latitude: °N Longitude: °W	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - Township - Range -

17. DIRECTIONS TO THE SITE

18. Nature of Activity (Description of project, include all features)

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres

or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

24. Is Any Portion of the Work Already Complete? ☐ Yes ☐ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address-

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

NORTH DAKOTA
DEPARTMENT of HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
www.ndhealth.gov

October 3, 2014

Mr. Nathan Boerboom, P.E., CFM
City of Fargo Engineering Department
200 3rd Street North
Fargo, ND 58104

Re: City of Fargo's Basement Exception
Cass County

Dear Mr. Boerboom:

This department has reviewed the information concerning the above-referenced project submitted under date of September 19, 2014, with respect to possible environmental impacts. We do not anticipate any environmental impacts from this project.

If you have any questions regarding our comments, please feel free to contact this office.

Sincerely,

L. David Glatt, Chief
Environmental Health Section

LDG:cc

HEIDI HEITKAMP
NORTH DAKOTA
HART SENATE BUILDING 502
WASHINGTON, DC 20510
PH: 202-224-2043
FAX: 202-224-7776
TOLL FREE: 1-800-223-4457
http://www.heitkamp.senate.gov

United States Senate

WASHINGTON, DC 20510

COMMITTEES:
AGRICULTURE, NUTRITION AND FORESTRY
BANKING, HOUSING AND URBAN AFFAIRS
HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS
INDIAN AFFAIRS
SMALL BUSINESS AND ENTREPRENEURSHIP

October 17, 2014

City of Fargo
Engineering Department
Attn: Nathan Boerboom
200 3rd Street North
Fargo, ND 58104

Dear Mr. Boerboom,

I appreciate the opportunity to provide comments on the importance of the basement exception for the city of Fargo.

Since this exception was granted by the Federal Emergency Management Agency in the 1970s, it has been an important part of the city's overall flood mitigation efforts in the region and effective implementation of the National Flood Insurance Program. With a new flood plain map expected, which will include more of the city in the 100-year flood plain, I believe the basement exception is a critical flood mitigation tool that must be continued.

For areas of the country like North Dakota where homeowners rely on basements for protection from severe weather, making sure this basement exception remains in place is imperative. Any change in construction practices to eliminate basements from homes would not only put residents at risk, but it could also result in higher construction costs, which could make purchasing a home less affordable for many. The continuation of the exception will ensure property owners will continue to be able to incorporate basements into new construction to protect them from severe weather while also ensuring they can mitigate their flood risk through floodproofing.

The city has been very proactive over the years in making the modifications necessary for floodproof basements to make sure residents are best equipped to mitigate their flood risk. The city serves as a model for how successful this basement exception can be in reducing flood risk and the positive impact it has on the region and property owners.

For these reasons, I strongly support the continuation of the basement exception within the city upon adoption of the new Flood Insurance Study.

Sincerely,

Heidi Heitkamp

Heidi Heitkamp
United States Senate

BISMARCK OFFICE:
228 FEDERAL BUILDING
220 EAST ROSSER AVENUE
BISMARCK, ND 58501
PH: 701-258-4648
FAX: 701-258-1254

DICKINSON OFFICE:
40 1ST AVENUE WEST
SUITE 202
DICKINSON, ND 58601
PH: 701-225-0974
FAX: 701-225-3287

FARGO OFFICE:
306 FEDERAL BUILDING
657 SECOND AVENUE NORTH
FARGO, ND 58102
PH: 701-232-8030 – 1-800-223-4457
FAX: 701-232-6449

GRAND FORKS OFFICE:
33 S. 3RD ST., SUITE B
GRAND FORKS, ND 58201
PH: 701-775-9601
FAX: 701-746-1990

MINOT OFFICE:
105 FEDERAL BUILDING
100 FIRST STREET S.W.
MINOT, ND 58701
PH: 701-852-0703
FAX: 701-838-8196

JOHN HOEVEN
NORTH DAKOTA
338 RUSSELL SENATE OFFICE BUILDING
TELEPHONE: (202) 224-2551
FAX: (202) 224-7999
hoeven.senate.gov

United States Senate

WASHINGTON, DC 20510

COMMITTEES:
AGRICULTURE
APPROPRIATIONS
ENERGY AND NATURAL RESOURCES
INDIAN AFFAIRS

October 17, 2014

Mr. Ryan Pietramali
Risk Analysis Branch Chief
FEMA Region VIII
United States Department of Homeland Security
PO Box 25267
Denver, CO 80225-0267

Dear Mr. Pietramali,

We understand that importance of the basement exception for the City of Fargo. This exception has been granted by Federal Emergency Management Agency (FEMA) since the mid-1970s, and is important part of Fargo's ability to implement the National Flood Insurance Program. We agree that the basement exception is crucial for Fargo to maintain since basement construction is common place in Fargo due to the local climate, and these basements serve as an important storm shelters during tornados. We are also aware that a change in construction practice that would no longer include basements could result in higher construction costs, which could make the purchase of homes less affordable to a larger population base.

The construction methods for floodproofing basements in Fargo has been very successful and is a good mitigation tool to reduce the risk property owners have due to flooding. Fargo has also been a leader in the region for continually updating what elevations should be required for floodproof basements to make certain that its residents are best situated for reduced flooding risks. Fargo has been a great example of successfully constructing floodproof basements and the positive effect that the basement exception has on the local community.

With Fargo's active floodplain management as well as the success of the floodproof basement construction, we would strongly support the continuation of the basement exception within the City of Fargo upon adoption of the new Flood Insurance Study this upcoming January. Thank you for your attention to this important matter.

Sincerely,

John Hoeven
U.S. Senator

CC: Nathan Boerboom, City of Fargo Engineering Department

KEVIN CRAMER
NORTH DAKOTA

WASHINGTON D.C. OFFICE:
1032 LONGWORTH BUILDING
WASHINGTON, DC 20515
202-225-2611

BISMARCK OFFICE:
220 EAST ROSSER AVENUE
SUITE 328
BISMARCK, NORTH DAKOTA 58501
701-224-0355

CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

FARGO OFFICE:
3217 FIECHTNER DRIVE, SUITE D
FARGO, NORTH DAKOTA 58103
701-356-2216

MINOT OFFICE:
315 MAIN STREET SOUTH, SUITE 203
MINOT, NORTH DAKOTA 58701
701-839-0255

GRAND FORKS OFFICE:
CENTER FOR INNOVATION FOUNDATION BUILDING
4200 JAMES RAY DRIVE, OFFICE 600
GRAND FORKS, NORTH DAKOTA 58202
701-738-4880

October 20, 2014

City of Fargo Engineering Department
Attn: Nathan Boerboom
200 3rd Street North
Fargo, ND 58104

Dear Mr. Boerboom,

Thank you for your letter dated September 19, 2014. I understand the importance of the basement exception for the City of Fargo. This exception has been granted by Federal Emergency Management Agency (FEMA) since the mid-1970s, and it is an important part of Fargo's ability to effectively implement the National Flood Insurance Program. I agree the basement exception is crucial for Fargo to maintain since basement construction is common in Fargo due to the local climate and the ability of these basements to serve as shelters during tornados. I also understand by no longer including basements housing construction costs could be increased, making the purchase of homes less affordable.

The construction method for floodproofing basements in Fargo has been very successful and is a good mitigation tool to reduce the risk property owners have due to flooding. Fargo has been a leader in the region for continually updating what elevations should be required for floodproof basements to make certain its residents are best situated for reduced flooding risks. Fargo has been a great example of successfully constructing floodproof basements and the positive effect that the basement exception has on the local community.

I strongly support the continuation of the basement exception within the City of Fargo upon adoption of the new Flood Insurance Study this upcoming January. Thank you for your attention to this important matter.

Sincerely,

Kevin Cramer
United States Congressman

USACE – Regulatory Office
Mr. Dan Cimarosti, State Program Manager
US Army Corps of Engineers
North Dakota Regulatory Office
1513 S. 12th St.
Bismarck, ND 58504

NRCS – Prime Farm Land
Ms. Mary E. Podoll, State Conservationist
U.S. Department of Agriculture - NRCS
P.O. Box 1458
Bismarck, ND 58502-1458

ND – Department of Health
Mr. David Glatt
Chief
Environmental Health Section
ND Department of Health
918 E. Divide Ave., 4th floor
Bismarck, ND 58501-1947

ND - SHPO
Mr. Merl Paaverud
ND State Historic Preservation Officer
ND Heritage Center
612 East Boulevard Avenue
Bismarck, ND 58505-0830

ND State Water Commission
Mr. Todd Sando
State Engineer
ND State Water Commission
900 E. Boulevard Avenue
Bismarck, ND 58505-0850

US – Fish & Wildlife
Kurt Tompkins
Supervisory Wildlife Refuge Specialist
Valley City Wetland Management District
11515 River Road
Valley City, ND 58072-9619

North Dakota Department of Emergency Services
Mr. Lonnie Hoffer
PO Box 5511 Bismarck, ND 58506

Bob Christensen
Cultural Resource Section
ND Department of Transportation
608 E. Boulevard Avenue
Bismarck, ND 58505-0700

Aaron Synder
St. Paul District – US Army Corps of Engineers
180 5th Street E, Suite 700
St. Paul, MN 55101-1678

Senator Heidi Heitkamp
US Federal Building, Room 228
220 E. Rosser Avenue
Bismarck, ND 58501

Senator John Hoeven
US Federal Building, Room 312
220 E. Rosser Avenue
Bismarck, ND 58501

Congressman Kevin Cramer
US Federal Building, Room 328
220 E. Rosser Avenue
Bismarck, ND 58501

Wade Kline
Executive Director
FM Metro COG
1 2nd Street N, Suite 232
Fargo, ND 58102

Jason Benson
Cass County Engineer
1201 Main Avenue W
West Fargo, ND 58078

Barb Fitzpatrick
NFIP Program Specialist
FEMA Region VIII
P.O. Box 25267, DFC
Bldg 710A
Denver, CO 80225

Congress of the United States
Washington, DC 20515

December 1, 2014

Mr. Craig Fugate
Administrator
United States Department of Homeland Security
Federal Emergency Management Agency-FEMA
500 C St SW
Washington, DC 20472-3198

Dear Administrator Fugate,

We are writing to express our support of the City of Fargo's application for the basement exception in the National Flood Insurance Program (NFIP). This exception, which has been granted to Fargo since 1975, has been crucial in Fargo's implementation of the National Flood Insurance Program.

Basements are an important part of the homes of Fargo residents. They serve as shelters during severe weather, and they have been effectively flood-proofed to reduce damage to the home. The construction methods of basements have allowed Fargo's residents to have access to reliable shelter that is both affordable to construct and insure. The residents of Fargo have made long-term investments in their homes by making sure that their basements are protected from significant flood damage. These floodproof basements have been an effective part of reducing risk of damage to the property due to flooding.

The City of Fargo has successfully implemented the basement exception in the NFIP for close to 40 years. Fargo has continually updated what elevations should be required for flood proof basements in order to minimize the risk of damage to the homes. The City of Fargo has proactively addressed the potential flooding issues in the past, and renewing Fargo's basement exception will help to continue this practice in to the future.

As the Federal Emergency Management Agency reviews Fargo's application for the basement exception, we urge the agency to keep in mind how important the basement exception is to the people of Fargo and strongly support its continuation. Thank you for your consideration of this important matter.

Sincerely,

John Hoeven
U.S. Senator

Heidi Heitkamp
U.S. Senator

Kevin Cramer
U.S. Congressman

CITY OF Fargo

ENGINEERING DEPARTMENT

200 3rd Street North
Fargo, North Dakota 58102
Phone: (701) 241-1545
Fax: (701) 241-8101
E-Mail: feng@cityoffargo.com

November 24, 2014

99

Honorable Board of City
Commissioners
City of Fargo
Fargo, North Dakota

Re: FEMA Basement Exception Request

Honorable Commissioners,

As you are aware the Preliminary FEMA Floodplain maps will become effective January 16, 2015. Staff has been working with FEMA to prepare for this event. As a part of the process we are required to review our current ordinances, policies, and procedures to determine if they still meet the minimum federal requirements. As such there are a number of changes that will be brought forth to the commission for consideration and approval in the coming months.

In addition, since we are a community that was previously approved for residential floodproofing rating credit (Basement Exception), we are required to submit to FEMA a request to continue that approval. Staff has prepared the attached package of information to serve as that submittal.

The requirements for the Basement Exception are spelled out in the Code of Federal Regulations 44 CFR 60.6c. Confirming that we could comply with regulation required a review of our current methods of construction of floodproof foundations. The requirements in the CFR cover a range of topics including: flood depths, flood velocities, flood warning times, water tight construction, depths of basements, compaction of fill, vegetative cover, and having procedures in place for the inspection of construction to confirm compliance.

With some modifications to our current practices we will be able to satisfy the requirements and comply with the rules outlined in the CFR with one exception area that we propose to seek a variance. The variance would be related to the depths of basements. Our current construction practices require that the foundations for structures extend down to previously undisturbed soil. In areas where we require the placement of fill to elevate the land out of the floodplain this means that the foundations must extend through the fill to the natural ground. The construction practice has been to place the basement floor on top of that foundation. In our area this means that the typical construction would exceed the limit of a five foot depth of basement below the BFE. The options are to comply with the code and elevate the basement floor to come into compliance, or to seek approval of our current building practices. We would like to seek approval of the current practice. If this is rejected by FEMA we would still have the ability to require the basement slab to be elevated. The consequence of doing so will cause the cost of construction to escalate. We understand that ultimately maintaining the previous approval for residential floodproofing rating credit is crucial.

Recommended Motion:

Authorize staff to submit the "Basement Exception" request to FEMA and direct staff to work with FEMA to maintain approval.

Respectfully,

April E. Walker

April E. Walker, P.E., C.F.M.

AEW/klo
Attachment

REPORT OF ACTION

PUBLIC WORKS PROJECTS EVALUATION COMMITTEE

Type: Floodproof Construction Policy Update

Location: Citywide

Date of Hearing: 4/20/2015

Routing	Date
City Commission	4/27/2015
PWPEC File	X
Project File	Nathan Boerboom

The Committee received a communication from Nathan Boerboom, Storm Sewer Utility Division Engineer, regarding proposed revisions and clarifications to the Floodproofing Policy that was adopted by the Commission in December. Since the implementation, staff has been working with developers and the Homebuilders Association to address areas requiring clarification. Nathan's memo enumerates these proposed changes and clarifications.

Staff has further identified a couple of areas where the current language has led to the potential for homes to be built at less than the intended elevation. A few areas have been identified where the 41' WSEIA +1.2 feet does not exceed or barely meets the State's requirement of BFE+1.0' foot. The proposed policy change would require elevation to be the higher of the 41' WSEIA+1.2' or BFE+2.0'.

Another identified issue is related to non-primary slab on grade structures such as detached garages or sheds. The current policy requires elevation to the 41' WSEIA +1.2'. In areas where this exceeds the BFE+1' staff is recommending that the requirement be relaxed to meet the State minimum of BFE+1.0'. These are non-insurable non-residential structures which makes staff comfortable with this adjustment.

Staff is recommending approval of the modified policy.

On a motion by Pat Zavoral, seconded by Mark Bittner, the Committee voted to recommend approval of the proposed modifications to the Floodproof Construction policy.

RECOMMENDED MOTION
Concur with the recommendations of PWPEC and adopt the proposed Floodproof Construction Policy.

PROJECT FINANCING INFORMATION:
Recommended source of funding for project: _____

	Yes	No
Developer meets City policy for payment of delinquent specials	N/A	
Agreement for payment of specials required of developer	N/A	
Letter of Credit required (per policy approved 5-28-13)	N/A	

COMMITTEE	Present	Yes	No	Unanimous
				☑
Pat Zavoral, City Administrator	☑	☑	☐	
Jim Gilmour, Director of Planning	☑	☑	☐	
Steve Dirksen, Fire Chief	☑	☑	☐	
Mark Bittner, Director of Engineering	☑	☑	☐	
Bruce Grubb, Enterprise Director	☑	☑	☐	
Ben Dow, Director of Operations	☑	☑	☐	
Steve Sprague, City Auditor	☑	☑	☐	
April Walker, City Engineer	☑	☑	☐	
Kent Costin, Finance Director	☑	☑	☐	

ATTEST:

April E. Walker, P.E., C.F.M.
City Engineer

CITY OF Fargo

Memorandum

To: PWPEC

From: Nathan Boerboom, Division Engineer – Storm Sewer Utility NAB

Date: 4/16/2015

Re: Revisions to the Floodproof Construction Requirements Policy

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As you may recall, this past winter the City needed to complete an update to our floodproofing structural design requirements as part of the basement exception renewal process, which was required by FEMA prior to the adoption of the new floodplain. To assist in updating the structural design, we contracted with KLJ to complete the analysis on the existing design and to provide revisions to the design as needed. During this analysis, City staff and KLJ worked closely with the Fargo-Moorhead Home Builders Association (HBA) to get their feedback on the proposed design as well as incorporate any additional items they saw necessary within the design. As a result of KLJ's analysis and HBA's feedback, we completed an update to the Floodproof Construction Requirements Policy that included the new structural design requirements as well as some clarifications to the floodproof elevation requirements. This policy was presented and approved by the City Commission in December.

As these new design requirements were starting to be incorporated into the design of new residential construction, we started to receive some questions from the HBA in regards to some of the revised requirements. As a result of these questions, we have had further meetings and detailed discussions with the HBA to gain additional feedback that has resulted in some revisions and clarifications being incorporated into the structural design requirements completed by KLJ. We believe that these clarifications and revisions have provided for the same level of floodproofing as before but with better implementation within the design as well as easier constructability of the basement walls compared to the previous version of the structural design requirements.

Some of the key items that were addressed within the revision to the structural design requirements are:

1. Clarifications and additional notes were made on the typical wall details shown in the figures to aid in quick identification of various requirements.
2. Addition of new figures to help illustrate some of the structural design requirements.
3. Clarifications were made to the tables to make them easier to understand.
4. Corrections were made to the maximum spacing of the bracing for perpendicular walls in Table 1B.
5. Addition of wall corner and opening reinforcement details that were inadvertently omitted in the original version. Requirements match the ACI 318-11 minimum requirements.
6. Waterproofing was modified to include provisions for Type D waterproofing as per the 1975 City of Fargo Floodproofing Code, which closely follows the dampproofing requirements of the 2012 IRC with minimum permeability ratings.
7. As a result of following Type D waterproofing requirements, the vapor retarder required below the basement floor slab is now allowed to be 10 mil poly instead of a 55 mil horizontal grade membrane.
8. Reinforcement details within the floor slab were added to the standard detail figures.
9. Additional wall design depths created for the bi-level basement wall section to account for a wide range of scenarios seen by the builders at the actual construction sites.

A copy of the revised structural design requirements has been provided with this memo for your review.

200 North 3rd Street
Fargo, ND 58102

Phone: (701) 241-1545
FAX: (701) 241-8101

Separate from the structural design requirements, we have also been coming across some unique situations regarding the minimum lowest opening elevation requirements on the floodproofing basements and when a floodproof basement is required. As you may recall, back in March of 2014, the City Commission passed a revision to the floodproofing policy that required a floodproof basement be constructed for any residential structure that is located within the 41-foot water surface elevation inundation area (WSEIA) as well as having the top of these basement walls and window wells be elevated 1.2-feet above the 41-foot WSEIA. This change was made since the modeling completed on the Red River as part of the FM Metro Diversion Project determined that the City's 1% annual chance flood (100 year floodplain) is closer to a 41-foot river stage instead of the effective FEMA 100 year floodplain elevation (BFE), which is equal to a 39.4-foot river stage. So the intent with the change to the floodproof construction requirements policy was to best position any new residential construction for any future changes to the floodplain and any associated flood insurance impacts due to any changes in the floodplain.

The unique situation that we have been seeing as a result of these new elevation requirements are that the current BFE is actually very close to the 41-foot WSEIA in some areas. The difference in the elevations is due to the different types of models being used for the current floodplain (steady-state flows) and the 41-foot WSEIA (unsteady-state flows). The issue with these being so close to each other is that there are some cases we found that do not meet the State of North Dakota's minimum elevation requirements of BFE plus 1.0-feet. So at a minimum we need to adjust our policy so that we clarify that the floodproofed elevation for a structure must meet the City's 41-foot WSEIA plus 1.2-feet or the State's BFE plus 1.0-foot requirement, whichever is greater. However, we believe that to best position future construction and minimize property at risk should be to have our policy adjusted to require that the floodproof elevation for a structure be the higher elevation between the 41-foot WSEIA plus 1.2-feet and the BFE plus 2.0-feet. Attached to this memo is a quick listing of some recent residential developments and how this proposed revision to the policy would look within said development. One thing to keep in mind when considering this revision is that we are requiring all residential lots in these new developments to be elevated by fill to the BFE (39.4') so that the property is removed from the floodplain and that historically the standard building practice has had the homes constructed on said lots being 30-inches higher than the curb on the street, which is set at the BFE.

We would maintain the current policy requirement on the trigger for when a structure is required to have a floodproof basement, which is with the property being located within the 41-foot WSEIA.

Another item we have been getting feedback on from the builders and developers is that the policy also requires any detached, non-primary, residential slab-on grade structures (such as a shed or garage) to be elevated according to the 41-foot WSEIA requirements. This is something that we would like modified in the policy to change the elevations for these detached, non-primary, residential slab-on grade structures to be required to meet the State's minimum elevation requirements of BFE plus 1.0-foot instead of the 41-foot WSEIA plus 1.2-feet. We are comfortable making this recommendation since these are not a primary structure and flood insurance cannot become mandatory for these structures if they become in the floodplain in the future.

All revisions being proposed can be seen in the attached copy of the Floodproof Construction Requirements Policy.

Recommended Motion

Accept the revisions to the Floodproof Construction Requirements Policy as presented to reflect modifications and clarifications completed to the structural design requirements, which were developed directly with the Fargo-Moorhead Home Builders Association.

NAB/jmg
Attachment

Comparison of 41' WSEIA to BFE

Comparison of 41' WSEIA plus 1.2-feet versus FEMA BFE plus 2.0-feet

		41' WSEIA	BFE	Difference
		909.6	908.3	
Crofton Coves	FPE	1.2	2.0	
		910.8	910.3	0.5
		909.6	908.8	
Eagle Pointe	FPE	1.2	2.0	
		910.8	910.8	0.0
		907.3	905.7	
The Pines	FPE	1.2	2.0	
		908.5	907.7	0.8
		906.8	907	
Golden Valley	FPE	1.2	2.0	
		908.0	909.0	-1.0
		906.7	906.7	
Prairie Farms	FPE	1.2	2.0	
		907.9	908.7	-0.8
		906.6	905.7	
Cottagewood	FPE	1.2	2.0	
		907.8	907.7	0.1
		906.7	905.7	
Valley View	FPE	1.2	2.0	
		907.9	907.7	0.2
		906.6	907.4	
Legacy & Martens Way	FPE	1.2	2.0	
		907.8	909.4	-1.6
		906.5	905.7	
Timber Creek	FPE	1.2	2.0	
		907.7	907.7	0.0
		906.8	905.7	
Veterans Park	FPE	1.2	2.0	
		908.0	907.7	0.3
		909.8	910.1	
Amber Plains	FPE	1.2	2.0	
		911.0	912.1	-1.1

Comparison of 41' WSEIA to BFE

		41' WSEIA	BFE	Difference
Prairie Moon Estates (Cossette Drive)		910.9	910.2	
	FPE	1.2	2.0	
		912.1	912.2	-0.1
Wild Rice River Estates (100 AveS)		911	910.2	
	FPE	1.2	2.0	
		912.2	912.2	0.0
Round Hill		910.5	910.1	
	FPE	1.2	2.0	
		911.7	912.1	-0.4

Floodproof Construction Requirements

CITY OF FARGO BUILDING
INSPECTION DIVISION
Updated ~~December 2014~~ April 2015

The State of North Dakota requires that you call *1-800-795-0555* at least two business days before you dig.

This handout does not address any covenants or easements assigned to the property, nor does it relieve you of code compliance with items which may not have been included from the International Codes.

REQUIREMENTS TO OBTAIN A BUILDING PERMIT FOR FLOODPROOF CONSTRUCTION

ALL PLANS MUST BE DRAWN TO SCALE

1. Floodproofing Certification Form from a State of North Dakota registered professional engineer. Required before Permit issuance.
2. Plot plan showing existing elevations of property.
3. Plot plan showing exact location of new building or addition and existing buildings.
4. Floor plan(s) of new building(s).
5. Elevation views of ~~all~~ two sides of the building. Elevation plans must show grade.
6. Foundation wall sections showing required construction details per City flood proof specifications. (See enclosed details.)
7. Foundation plans showing drain tile location and footings.

THE FOLLOWING ITEMS ARE INCLUDED IN THIS PACKET

A. Typical Floodproofing Construction Requirements Exhibits

B. Foundation and basement wall structural details from *Floodproof Basement Structural Design Requirements Report*, created by KLJ, ~~dated~~ created December 17, 2014~~.~~ and revised April 9, 2015.

C. **For informational purposes only –** Inspection log for foundation. Actual log is completed electronically and done ~~Inspections will be completed~~ by City of Fargo Inspection Department.

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D. FEMA Residential Floodproofing Certificate.

E. FEMA Non-Residential Floodproofing Certificate.

A CERTIFICATE OF OCCUPANCY WILL BE REQUIRED BEFORE BUILDING OCCUPANCY

CITY OF FARGO POLICY STATEMENT FOR FLOODPROOFING ELEVATION REQUIREMENTS

Referenced to the following:

Fargo Municipal Code Article 21-06 (Flood Plain Management)
Floodproofing Code of the City of Fargo, North Dakota, prepared by Moore Engineering, Inc., Revised December 9, 1975

Applicable to the following:

This Policy Statement shall regulate development within City of Fargo City Limits and Extra Territorial Areas. The specific areas governed, by this policy are the FEMA 1% annual chance floodplain and the 41-foot water surface elevation inundation area.

I. All Structures

All structures, including but not limited to, residential, commercial, and industrial construction within the city limits and extra territorial areas shall meet the following requirements:

A. Floodway Setback
All structures must be set back 100' from floodway line

B. Watercourse Setbacks
All provisions of the Minimum and Limited Disturbance Setbacks zones as identified under City Municipal Code §20-0508 shall be met.

C. Primary Flood Protection Line
1. All properties adjacent to a river, drainage ditch or other flooding source, as determined by the City Engineer, must include a primary flood protection line.
2. Primary flood protection line elevation shall be FEMA Base Flood Elevation (BFE) plus 4.0'.
3. Primary flood protection line must be constructed throughout a proposed development (not on a lot by lot baisis) prior to issuance of any building permits.
    a. Plats approved by City Commission prior to March 4, 2014 may have a primary flood protection line constructed on a lot by lot basis. Protection line must be completed at the time of issuance of occupancy certificate.
4. Primary flood protection line shall be constructed according to the City of Fargo Standard Specifications, Section 3600.

D. Letter of Map Revisions (LOMR)
The City of Fargo encourages construction outside of the FEMA Special Flood Hazard Area (SFHA) and requires removal from the SFHA by Letter of Map Revision (LOMR) via fill or ring dike.
1. All fill placement shall follow the current City of Fargo Standard Specifications, Section 3600.
2. No more than five feet (5') of fill may be placed for buildings in areas removed from FEMA SFHA by LOMR
    a. Fill in excess of five feet may be permitted, provided the fill is Engineered fill designed by a State of North Dakota registered professional engineer and the design plan is provided to the City in advance of construction.
3. All structures constructed within LOMR areas must meet all floodproofing codes.

E. Infrastructure Elevations
1. All streets are to be constructed to a minimum of FEMA BFE minus 0.5' at the low point (Back of Curb to be at FEMA BFE)
2. All sanitary sewer facilities, including private sewer connection manholes, cleanouts, etc. must be protected to an elevation equal to the FEMA BFE. Protection measures include sealing and/or elevating.
3. Storm sewer system shall be protected by infrastructure designed to be at or above an elevation of FEMA BFE plus 5.0'

F. Certifications
1. Elevation Certificates are required for all flood proofed structures.
2. Elevation Certificates for existing non flood proofed structures may be required if the structure is located in the FEMA SFHA.
3. Pre- Construction Floodproof Certification Form from FEMA is required for floodproof foundations, and must be provided to the City at the time the Building Permit is requested.

II. Single Family and Multi-Family Residential Structures Within 41-foot Water Surface Elevation Inundation Area (WSEIA) (See Exhibit A)

All construction within the 41-foot WSEIA as determined by the City Engineer shall meet all floodproofing codes, in addition to the following elevation and fill requirements:

A. Elevations

• *Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2' Or equal to FEMA BFE plus 2.0'
• *Fill around building	Equal to 41-foot WSEIA plus 0.7' Or equal to FEMA BFE plus 1.5'
• Fill 15' away from buildings	At or above FEMA BFE

* Highest elevation of the two shall govern required minimum elevations

B. All underground parking must meet floodproofing codes, including the above specified elevation and fill requirements.

C. Elevations of detached, non-primary, slab on grade structures located on single and multi family lots shall have the elevation of the finished floor to be at or above the FEMA BFE plus 1.0'.

III. Single Family and Multi Family Residential Structures Outside the 41- foot WSEIA

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'
Fill around building	Equal to 41-foot WSEIA plus 0.7'

B. Foundations — No special requirements

IV. All Structures (Excluding Residential) Within the FEMA 1% Annual Chance Floodplain (See Exhibit A)

All construction within the FEMA 1% annual chance floodplain as determined by the City Engineer shall meet all floodproofing codes, in addition to the following elevation and fill requirements:

A. Elevations

• *Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2' Or equal to FEMA BFE plus 2.0'
• *Fill around building	Equal to 41-foot WSEIA plus 0.7' Or equal to FEMA BFE plus 1.5'
• Fill 15' away from buildings	At or above FEMA BFE

* Highest elevation of the two shall govern required minimum elevations

B. All underground parking must meet floodproofing codes including specified elevation and fill requirements.

C. Structures within a contemplated LOMR area with a proposed depressed loading dock will be allowed to have the loading dock area below the specified adjacent ground elevations if the building is a slab on grade with the lowest finished floor elevation of the structure at the WSEIA plus 1.2'.

V. All Structures (Excluding Residential) Outside of the FEMA 1% annual chance floodplain (See Exhibit B)

A. Elevations

Lowest opening including area walls	Equal to 41-foot WSEIA plus 1.2'
Fill around building	Equal to 41-foot WSEIA plus 0.7'

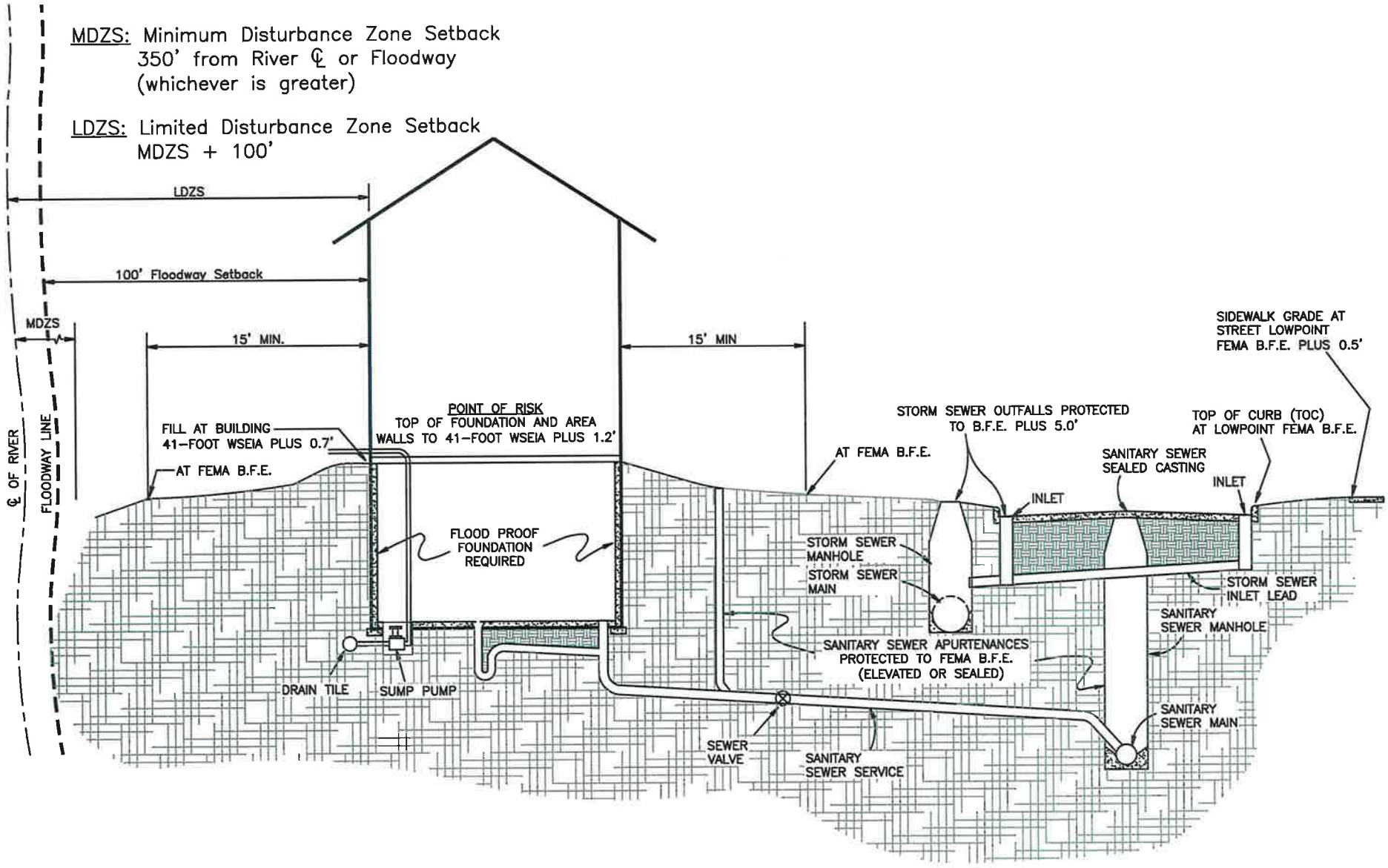
B. Foundations

Setback dimensions are determined by the FEMA 1% annual chance floodplain polygon edges.

1. If building within 25-feet of the FEMA 1% chance floodplain, all construction must conform to all floodproof codes.
2. If building within 50-feet of the FEMA 1% chance floodplain, standard concrete foundations are required, floodproof construction is recommended.
3. If building is more than 50-feet from the FEMA 1% chance floodplain, there are no special requirements although floodproof construction is recommended.

APPENDIX A

TYPICAL FLOODPROOFING CONSTRUCTION REQUIREMENTS EXHIBITS



Single Family & Multi Family Residential Structures
within the 41.1 foot Water Surface Elevation Inundation Area

Non Residential Structures
within the FEMA 1% Annual Chance Floodplain

CITY OF Fargo
Engineering Dept.

Scale: NTS

Flood Proofing Construction Requirements Exhibit "A"

2/26/2014
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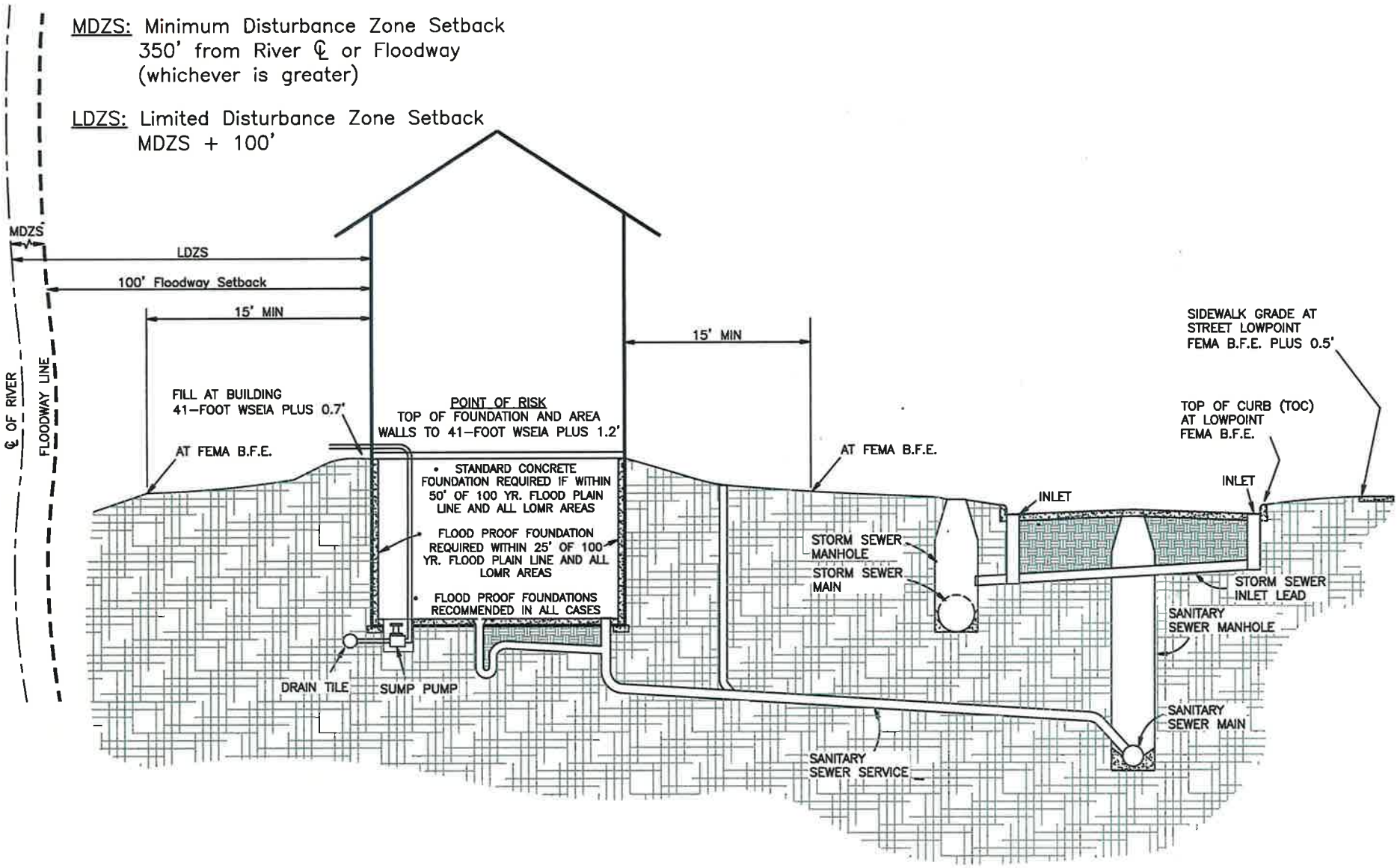

Non Residential Structures
within 50' of the FEMA 1% Annual Chance Floodplain

CITY OF Fargo
Engineering Dept.

Scale: NTS

Flood Proofing Construction Requirements Exhibit "B"

2/26/2014
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CITY OF Fargo

APPENDIX B

FLOODPROOF BASEMENT STRUCTURAL REQUIREMENTS REPORT

Prepared for:

City of Fargo
Engineering Department
200 3rd Street North
Fargo, ND 58102

Prepared by:

KLJ
728 East Beaton Drive
Suite 101
West Fargo, ND 58078

December 17, 2014
Revision 1: April 9, 2015

Structural Design Requirements

Floodproofed Basements in Fargo, ND

KLJ

I. Executive Summary

KLJ and Braun Intertec (Braun) were asked to review the structural requirements of the City of Fargo's existing Floodproofing Code as they relate to current industry practices and design codes. The existing code has performed well under flooding conditions since its inception and has been tested multiple times including major floods of 1997 and 2009. However, the structural requirements have changed very little since it was first created in 1975. The recommendations included herein are based on industry standards and current building code requirements.

II. Analysis

Upon review of documents used to develop previous floodproofing codes, it was determined more information should be gathered related to the soils in the Fargo area and how they affect the structural design requirements for floodproofing basements. Braun prepared a geotechnical evaluation for this report which included a seepage analysis and recommendations for lateral earth pressures. Conclusions drawn from the geotechnical evaluation where used to develop the structural design requirements included herein.

A. Seepage Analysis

Braun was asked to perform a seepage analysis on the soils in the Fargo, North Dakota area. The results of their findings are included in Appendix A of this report. A summary of Braun's findings are as follows:

1) Based on discussions with the Fargo-Moorhead Home Builder's Association, foundations on most lots are currently being built on fairly shallow excavations. For the Fargo area, the soils at this depth are a part of the Sherack formation. The fill material brought in to build up the sites is also typically from this formation.

2) The soils in the Sherack formation are typically impervious, but some silt lenses are known to exist. The silt lenses can be troublesome as water can travel through them.

3) Laboratory testing was performed to determine the hydraulic conductivity of the soils in the Fargo area. Hydraulic conductivity is a measurement used to describe the flow of water through the soil. The tests indicate the soils in the Sherack formation have a hydraulic conductivity of 1E-4 foot per day vertically. Observation of local construction projects indicates the horizontal conductivity of 1E-3 foot per day. These numbers indicate the soils in the Fargo area are impermeable and water does not travel well through the Sherack. It should be noted, however, these values reflect well compacted material, and realistic values for backfill against homes would be "1 to 2 orders of magnitude faster."

4) Groundwater elevations vary throughout the year between five to ten feet below grade. Interviews with local homeowners indicated that bi-level basements (four feet below grade) had sump pumps that ran only during wet seasons and full depth basement sump pumps ran year round.

5) A seepage analysis concluded that basements with a 15 foot setback to the BFE (base flood elevation) would not infiltrate a house foundation for several months for a basement that is nine feet below grade. It was noted that if flood waters were allowed to reach the home during the peak flood the soil could become saturated causing hydrostatic pressures to be of concern. A peak flood was assumed to last "several days to 2 weeks before receding."

B. Lateral Earth Pressures

Braun recommends using an active equivalent fluid pressure of 65 pounds per cubic foot (PCF) per foot depth for soils in the Sherack formation to design basement walls. In order for this assumption to be accurate, the following criteria must be met:

1) Basements should have a flexible diaphragm and adequate subsurface drainage for this assumption to be accurate.

2) A wood floor and subfloor above the basement is considered a flexible diaphragm.

3) Adequate surface drainage must be provided around the perimeter of the home. If silt lenses or sand are found in excavations, the excavations should be over-excavated by at least ten feet horizontally from the basement walls and backfilled with fat clay soils, similar to that of the Sherack formation.

4) If flood water comes in contact with the house or backfill or if the drain tile/sump pump fails, considerations should be made to flood the basement to minimize structural damage due to hydrostatic pressures.

C. Structural Design Requirements

KLJ performed an analysis on basement wall construction for full depth basements and bi-level basements in Fargo based on the design parameters provided by Braun and design requirements detailed in the U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314.* A summary of the analysis is included in the following sections.

DESIGN CODES:

Analysis of basement wall construction shall comply with the following building codes:

1) 2012 International Building Code (2012 IBC)

2) 2012 International Residential Code (2012 IRC)

3) American Concrete Institute 318-11: Building Code and Commentary (ACI 318-11)

4) 2012 National Design Specification (2012 NDS) for Wood Construction

STRUCTURAL LOADS:

1) Hydrostatic loads on the structure need not be considered with a 15 foot setback to the BFE. Under these conditions, Braun's seepage analysis determined it would take several months to saturate the soil adjacent to the basement walls. Given that peak floods only last about two weeks and homes are being constructed with a subsurface drainage system, the probability is very low that flood waters would reach foundation walls.

2) Hydrodynamic loads on the structure do not need to be considered. As per the *Flood Insurance Study* booklet prepared by FEMA for Cass County, North Dakota (effective January 16, 2015), the mean velocity of the Red River varies between 0.8 and 2.5 feet per second. The U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* states hydrodynamic loads need only be considered with velocities of five feet per second or greater.

3) Impact loads do not need to be considered as the probability that flood water elevations would exceed the ground elevation adjacent to the structure would be minimal.

4) Buoyancy is not a concern with flood and groundwater levels being maintained below the basement slab with a subsurface drainage system.

5) Basement walls and their connections shall be designed using an active equivalent lateral earth pressure of 65 PCF.

ANALYSIS:

KLJ completed a structural analysis on full height, bi-level and window well basement walls using the design codes and loads listed above. Tables and figures associated with the analysis are provided in Appendix B. A summary of the design procedure used to develop each table and figure is as follows:

1) Full height basement walls:

   a) Two reinforcing options are provided in Tables 1A and 1B.

      i) Case A includes provisions for 2-way slab action in the concrete walls to minimize the connection requirements at the top of the wall.

      ii) Case B also accounts for 2-way action in the concrete walls and allows for maximum spacing between walls perpendicular (i.e. jogs) to the foundation wall. Minimum reinforcing is based on the worst case between temperature and shrinkage steel or steel required to achieve moment capacity.

      iii) A detail of the reinforcing requirements is provided in Figure 1.

   b) The wall is required to be braced at the top where the trusses run parallel to the wall as per the requirements of Table 1B. An approved bracing detail is provided in Figure 5.

2) Bi-level basement design was based on a cantilevered concrete foundation wall. Reinforcing requirements are provided in Table 2 and a detail of the wall construction is provided in Figure 2.

3) Window well walls were designed to span horizontally. Reinforcing requirements are included in Table 3. A detail of the wall construction is provided in Figure 3.

4) Reinforcing requirements at wall corners and openings are provided in Figures 4A and 4B respectively.

D. Dampproofing

Dampproofing is required on the exterior surface of all basement walls and below all basement slabs. The dampproofing shall be continuous from the top of the soil to the top of the footing. The following recommendations meet the U.S. Army Corps of Engineers *Flood Proofing Regulations, EP 1165-2-314* Type B and the City of Fargo Flood Proofing Code (1975) Type D dampproofing. Dampproofing shall be required to be substantially impermeable but may pass water vapor and seep slightly during flooding.

1) Foundation wall: Foundation dampproofing shall meet the requirements of Section R406.1 of the 2012 IRC. In addition, the dampproofing shall have a minimum Class II perm rating.
2) Under slab: The under slab vapor retarder shall consist of a 10 mil polyethylene with a minimum Class II perm rating.

III. Conclusions

An active equivalent lateral earth pressure of 65 PCF shall be used as the basis of design for floodproofing basement structures. Tables and figures are provided in Appendix B to assist with construction of the wall construction types presented herein. The following conditions must be met to comply with the design recommendations included in this report:

1) Basement shall be constructed as per Exhibit A in the City of Fargo's *Floodproof Construction Requirements*.

2) Drain tile or other approved subsurface drainage be provided around interior and exterior basement perimeter and tied into an appropriately sized sump pit with a functioning sump pump.

3) The basement shall be dampproofed with the products included in this report (or approved equivalents).

4) In the event overtopping is eminent or the sump pump fails and is not able to be reinstated in a timely manner, it is recommended the basements be filled with clean water to minimize structural damage as a result of hydrostatic pressure and uplift.

Appendix A

Geotechnical Reports

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
526 10th Street NE, Suite 300
P.O. Box 485
West Fargo, ND 58078

Phone: 701.232.8701
Fax: 701.232.7817
Web: braunintertec.com

November 24, 2014

Project B14-07345

Cassie McNames, PE
KLJ, Inc.
728 East Beaton Drive, Suite 101
West Fargo, ND 58078

Re: Geotechnical Evaluation Letter
City of Fargo Project #MS-14-71
Floodproof Basement Structural Review
Fargo, North Dakota

Dear Ms. McNames:

This Geotechnical Evaluation Letter addresses geotechnical aspects of the City of Fargo's Floodproof Basement Structural Review.

Background

We understand the original design of the City of Fargo's floodproof basement was completed in 1975 and at that time the City was able to receive a basement exception from FEMA. As part of the current FEMA floodplain remapping process, the City is required to renew their basement exception with FEMA. As part of this renewal we understand KLJ is assisting the City with a structural analysis of the standard basement wall detail. The City requested that you engage a geotechnical engineer to provide recommendations for soil parameters to be used in design of the wall as well as a seepage analysis to estimate the timeframe for full saturation of soil adjacent a basement wall.

Information Reviewed

In preparation of this letter, we reviewed a number of documents and resources. These documents and resources are listed below along with some of the key takeaways we considered from each.

- August 27, 1974 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Soil Pressures in the Fargo-Moorhead Area.
  - Design walls to withstand an equivalent fluid pressure of 120 pcf.
  - Install a drain tile system at the perimeter and below the floor to control uplift.
  - Backfill utility connection trenches with well compacted clayey soil to prevent easy flow nets for infiltrating water.
  - All sites should be checked by a knowledgeable individual to determine that there is not an unusual uniform silt condition present or pervious fill.
- February 24, 1975 letter from Soil Exploration Company to Ulteig Engineers, Inc. Re: Basement Soil Pressures in the Fargo-Moorhead Area.
  - Ulteig and SEC discussed several homes that were completely surrounded by floodwater for 2 weeks (although overland flow did not reach the basement walls). The homes were

not designed for a maximum soil pressure [120 pcf] and the basement walls were not affected by horizontal soil pressure.
    - A design of less than the maximum soil pressure should provide for construction detail that will insure the maximum stress will not occur.
    - A lesser design soil pressure value was not stated, but it was stated that a "solution within reasonable economic means can be obtained" if freestanding water will not be adjacent the walls, surrounding soils are cohesive and relatively impervious, a drain tile system is in place to collect seepage, easy flow channels to the structure be prevented, utility trenches should be backfilled with cohesive soils and well compacted, gravel fill under driveways and so forth should be kept above flood levels, adequate surface drainage must be maintained away from the structure, and down spouts and local runoff cannot allow ponding adjacent walls.
    - The homeowner should be informed that his basement is not designed to withstand full hydrostatic pressure and he should understand the necessity of maintaining the drain tile system and that if the system fails or if flood waters make approximate contact with the basement walls, the basement should be flooded.
- City of Fargo Code of Ordinances, Article 21-0102, Section 1610.1
    - Exception to International Building Code: Foundation walls extending not more than 9 feet below grade and laterally supported at the top by flexible diaphragms shall be permitted to be designed for active pressure.
- Home Builders Association meeting on October 15, 2014
    - Currently on LOMR lots, excavations to bottom of foundation level are typically about 1 to 3 feet below natural ground and the remainder of the pad is built up from there.

Discussion

Soils

The soils in the City of Fargo were deposited by Glacial Lake Agassiz and are rather consistent across the City. The soils within the typical basement depth of not more than 9 feet consist of what is known as the Sherack formation. As they exist in the upper 9 feet, materials from this formation are most often used as basement wall backfill and from our experience they are also most often used as fill on LOMR lots.

The Sherack formation consists of fat clay that is rather impervious, but is sometimes stratified with silt or sand seams and layers that will increase its hydraulic conductivity. The Sherack formation most often weighs about 115 pcf in its normal, wet condition. Numerous shear strength tests we have performed on material from the Sherack formation indicate that if well compacted it will have a typical internal friction angle of about 25 degrees. Since house pad excavations are relatively small in size, they limit the size of compaction equipment and the overall effectiveness of compaction effort. To account for this we have assumed the internal friction angle for wall design of about 2/3 this value, or 16 degrees. This assumption should not relieve the contractor from the need for compaction of the backfill.

The conductivity of the Sherack formation averages approximately 1E-4 ft/day vertically (as determined from our laboratory testing) and 1E-3 ft/day horizontally (as determined through the in-situ monitoring of pore water pressure dissipation on local embankment construction projects). The conductivity of backfill is highly variable and dependent on material type, placement and level of compaction. Well compacted backfill would likely have conductivity values similar to those stated for the Sherack formation, while poorly compacted backfill is likely 1 to 2 orders of magnitude faster.

Groundwater
Measured groundwater depths typically vary across the City with location and season, but we have found that most often groundwater is encountered within about 5 to 10 feet of the ground surface seasonally. With regards to sump pump operation, we interviewed 12 homeowners across the City with variability in location, age of home, and depth of basement. The responses were very consistent in that homeowners with split level structures, or 4-foot deep basements, had sump pumps that ran only during rainy periods and homeowners with full basements had sump pumps that ran outside of rainy periods and several stated year round. These interview results would support the groundwater measurements we have observed within 5 to 10 feet of the ground surface.

Analysis

We performed a seepage analysis using a finite element program called SEEP/W from GeoStudio. The analysis was performed for a home with soil conditions typical of the Fargo area. We assumed that the basement is 9 feet below the ground surface and that flood waters would not be closer than 15 feet from the basement wall. The 15-foot distance was selected as it is typically greater than the excavation width for a basement wall and it is also currently the requirement by the City of Fargo for the minimum distance from the BFE for flood proofing construction.

The analysis indicates that the flood waters would have to be in place for several months for water to infiltrate to the house foundation or even the normal backfill wedge against a house. Peak flood conditions in this area typically last several days to as much as about 2 weeks before receding. It should be noted that if flood water contacted a basement wall and covered the wall backfill, saturation of the backfill could occur within the normal timeframe of peak flood conditions.

Recommendations

For design of basement walls we recommend using an active equivalent fluid pressure of 65 pcf per foot of depth (this value does not include a factor of safety). This value assumes the soil conditions noted in the *Discussion* above, and that the wall has a flexible diaphragm, and also assumes that the house has a functioning drain tile system. Many basements are constructed above the groundwater, but even those that are below the groundwater (estimated at 1 to 2 feet maximum seasonally) can experience drawdown of the groundwater below the active pressure zone on the wall if a properly functioning drain tile system is in place.

To use this value we further recommend that grades within 10 feet horizontal of the perimeter of the house should be sloped down and away from the structure at a minimum gradient of 5 percent to prevent ponding, and all roof run-off should be collected by gutters and routed to drains with long downspouts, which are diverted to areas more than 5 to 10 feet from the structure.

If basement excavations encounter layers of sand or silt, the excavations should be constructed so that they extend at least 10 feet away from the basement walls, and the entire excavation should be backfilled with fat clay soils typical of the area to lessen seepage through the sand/silt layer towards the structure.

As noted by Soil Engineering Company, we agree that if flood water comes in contact with the house or wall backfill, or if the drain tile system fails during periods of flooding, the homeowner should consider flooding the basement to limit structural damage to the basement wall.

Remarks

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions about this Letter, please contact Nate McKinney or Sean Swartz at 701.232.8701.

Sincerely,

BRAUN INTERTEC CORPORATION

Sean S. Swartz, PE
Principal Engineer

Professional Certification:
I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of North Dakota.

REGISTERED PROFESSIONAL ENGINEER
NATHAN
McKINNEY
PE-6735
DATE 11/24/14
NORTH DAKOTA

Nathan L. McKinney, PE
Principal – Senior Engineer
Registration Number: PE-6735
November 24, 2014

Appendix B

Tables and Figures

Table 1A: Minimum Reinforcement Requirements for Floodproofed Basement Walls - Full Height Walls (65 pcf)

Case A: Allows for minimum anchorage at the top of the wall

Case B: Allows for maximum spacing between perpendicular walls

Wall Height (ft)	Case	Wall Thickness (in)	Vertical Reinforcing	Horizontal Reinforcing	Maximum Horizontal Distance between Perpendicular Foundation Walls (ft)[7]	Dowel Spacing (ft)
7.5	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 40 " o.c.	7.5	4'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 22 " o.c. # 5 @ 30 " o.c. # 6 @ 44 " o.c.	# 4 @ 24 " o.c.	15	1'-10" o.c.
		10	# 4 @ 24 " o.c. # 5 @ 36 " o.c. # 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			
8	A	8	# 4 @ 24 " o.c.	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 40 " o.c.	8	2'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 18 " o.c. # 5 @ 26 " o.c. # 6 @ 40 " o.c.	# 4 @ 24 " o.c.	16	1'-6" o.c.
		10	# 4 @ 24 " o.c. # 5 @ 36 " o.c. # 6 @ 52 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			
9	A	8	# 4 @ 24 " o.c.	# 4 @ 14 " o.c. # 5 @ 22 " o.c. # 6 @ 28 " o.c.	9	2'-0" o.c.
		10		# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 28 " o.c.		
		12		# 4 @ 9 " o.c. # 5 @ 15 " o.c. # 6 @ 21 " o.c.		
	B	8	# 4 @ 12 " o.c. # 5 @ 18 " o.c. # 6 @ 26 " o.c.	# 4 @ 24 " o.c.	18	1'-0" o.c.
		10	# 4 @ 16 " o.c. # 5 @ 24 " o.c. # 6 @ 36 " o.c.			
		12	# 4 @ 18 " o.c. # 5 @ 28 " o.c. # 6 @ 38 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between 1-1/2 and 2-1/2 inches from the inside face of the wall.
4. Minimum concrete stregnth, f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Minimum length of perpendicular wall or "jog" shall be 2 feet. Perpendicular wall shall be the same thickness and reinforcing as wall it supports, and may be up to 1'-0" less in height than foundation wall. Perpendicular walls must be placed on minimum 1'-8" strip footing placed integral with foundation wall footing. Window wells are considered to be a perpendicular wall.
8. Refer to Table 1B for connection requirements at the top of the wall.
9. Refer to Figure 1 for basement wall detail.
10. Refer to Figure 4A for reinforcing at wall corners.
11. Refer to Figure 4B for reinforcing at openings in walls.
12. Refer to Figure 5 for wall bracing at foundation walls parallel to floor trusses.

Table 1B: Minimum Connection Requirements for Floodproofed Basement Walls - Full Height Walls (65 pcf)

Case A: Allows for minimum anchorage at the top of the wall

Case B: Allows for maximum spacing between perpendicular walls

Wall Height (ft)	Case	Sill Plate	Optional Top Plate Nailing Pattern	Anchor Bolt	Connection @ Truss	Bracing @ Walls Parallel to Trusses[11]	
						Max. Spacing	Conn. to Sill Plate
7.5	A	2-2x	16d @ 6 " o.c.	1/2" ϕ @ 20 " o.c.	A34 @ ea. Truss	4'-0"	2-A35 Clips
				5/8" ϕ @ 26 " o.c.			
				3/4" ϕ @ 32 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 11 " o.c.	2-A35 @ ea. Truss	2'-2"	2-A35 Clips
				5/8" ϕ @ 14 " o.c.			
				3/4" ϕ @ 18 " o.c.			
8	A	2-2x	16d @ 5 " o.c.	1/2" ϕ @ 18 " o.c.	A35 @ ea. Truss	3'-6"	2-A35 Clips
				5/8" ϕ @ 24 " o.c.			
				3/4" ϕ @ 30 " o.c.			
	B	2-2x	16d @ 3 " o.c.	1/2" ϕ @ 9 " o.c.	2-A35 @ ea. Truss	1'-10"	2-A35 Clips
				5/8" ϕ @ 12 " o.c.			
				3/4" ϕ @ 15 " o.c.			
9	A	2-2x	16d @ 4 " o.c.	1/2" ϕ @ 14 " o.c.	A35 @ ea. Truss	2'-9"	2-A35 Clips
				5/8" ϕ @ 18 " o.c.			
				3/4" ϕ @ 22 " o.c.			
	B	2-2x	16d @ 2 " o.c.	1/2" ϕ @ 8 " o.c.	2-A35 @ ea. Truss	1'-6"	2-A35 Clips
				5/8" ϕ @ 10 " o.c.			
				3/4" ϕ @ 12 " o.c.			

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Anchor bolts shall be ASTM F1554 Grade 36.
3. Minimum clear distance between bolt and edge of concrete shall be no less than 2 inches.
4. Minimum concrete stregnth, f_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Backfill shall not be placed until first floor framing and sheathing is installed and fastened or adequately braced and the concrete floor slab is in place or the wall is adequately braced.
7. Refer to Table 1A for reinforcing requirements.
8. Refer to Figure 1 for basement wall detail.
9. Refer to Figure 4A for reinforcing at wall corners.
10. Refer to Figure 4B for reinforcing at openings in walls.
11. Refer to Figure 5 for wall bracing at foundation walls parallel to floor trusses.

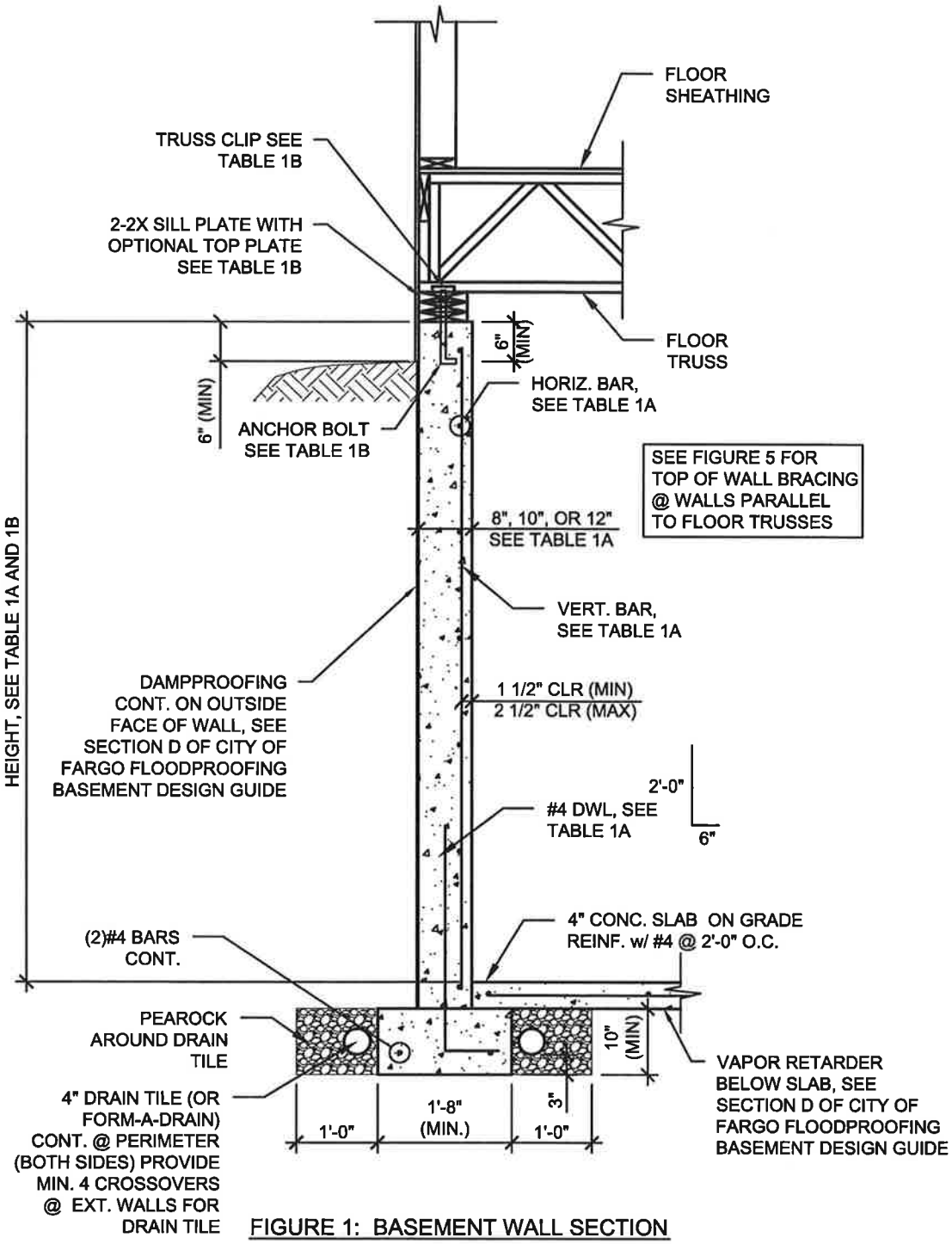


FIGURE 1: BASEMENT WALL SECTION

Table 2: Minimum Reinforcement for Floodproofed Basement Walls - Bi-Level Walls (65 pcf)

Wall Height, H (ft)	Wall Thickness (in)	Vertical Reinforcing	Horizontal Reinforcing
5 (max)	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.
		# 5 @ 30 " o.c.	
		# 6 @ 40 " o.c.	
	10	# 4 @ 18 " o.c.	
		# 5 @ 26 " o.c.	
		# 6 @ 36 " o.c.	
	12	# 4 @ 12 " o.c.	
		# 5 @ 20 " o.c.	
		# 6 @ 28 " o.c.	

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between 1-1/2 and 2-1/2 inches from the outside face of the wall.
4. Minimum concrete stregnth, f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 2 for basement wall detail.
7. Refer to Figure 4A for reinforcing at wall corners.
8. Refer to Figure 4B for reinforcing at openings in walls.

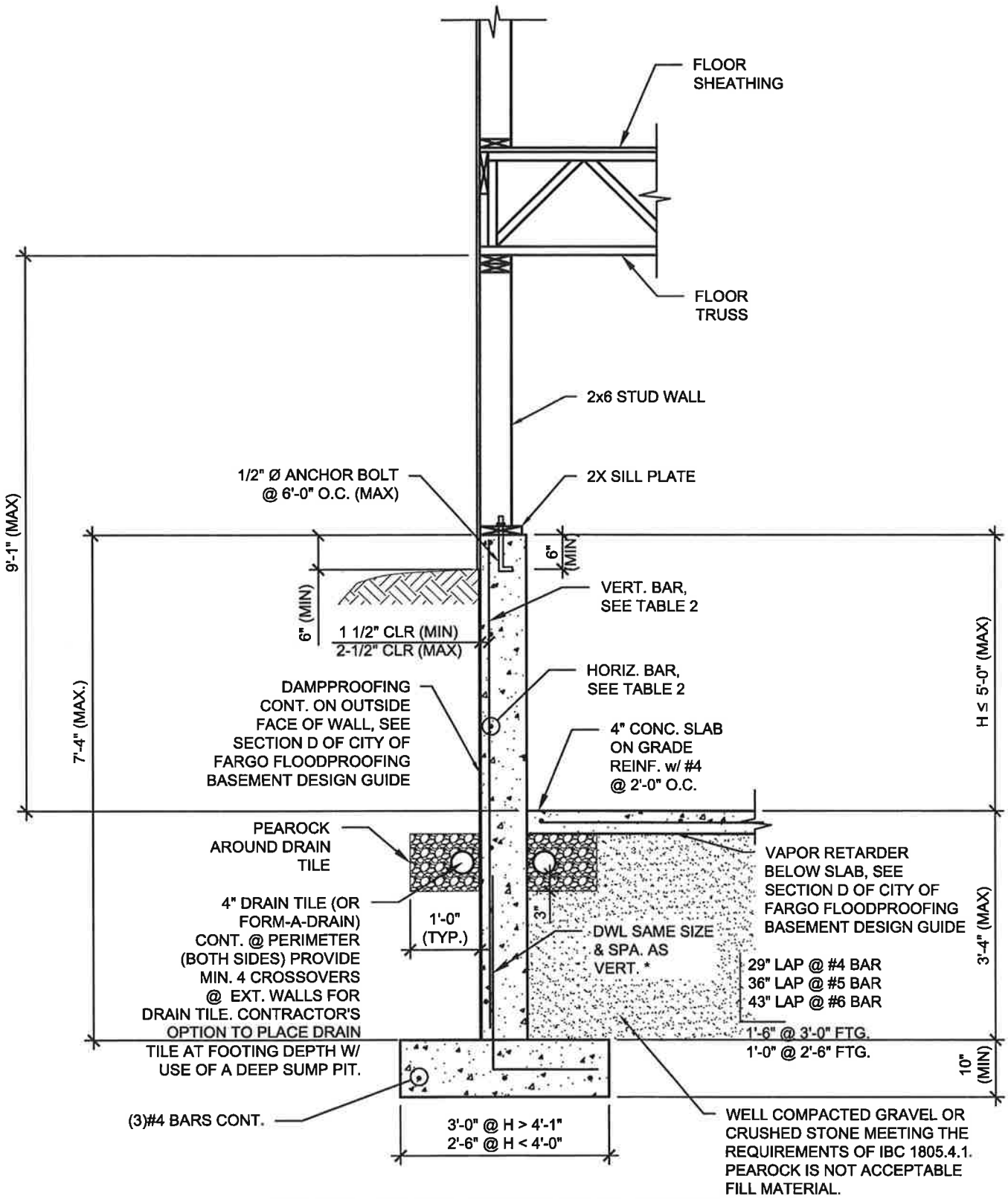


FIGURE 2: BI-LEVEL BASEMENT WALL SECTION

*NOTE: CONTRACTOR'S OPTION TO SUPPLY VERTICAL REINF. WITH HOOK INTO FOOTING AND OMIT DOWEL BAR.

Table 3: Minimum Reinforcement for Floodproofed Basement Walls - Window Well Walls (65 pcf)

Wall Height (ft)	Wall Thickness (in)	Horizontal Reinforcing	Vertical Reinforcing	Max. Horizontal Span between Perpendicular Foundation Walls (ft)[9]
7.5	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0"
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0"
		# 4 @ 12 " o.c.		7'-6"
		# 4 @ 9 " o.c.		10'-0"
8	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	4'-0"
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-6"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	6'-0"
		# 4 @ 12 " o.c.		7'-0"
		# 4 @ 9 " o.c.		9'-6"
9	6	# 4 @ 24 " o.c.	# 4 @ 24 " o.c.	3'-6"
		# 4 @ 18 " o.c.		5'-0"
		# 4 @ 12 " o.c.		6'-0"
	8	# 4 @ 18 " o.c.	# 4 @ 24 " o.c.	5'-6"
		# 4 @ 12 " o.c.		6'-6"
		# 4 @ 9 " o.c.		9'-0"

Notes:

1. Chart is based on an active soil pressure of 65 pounds per cubic foot (pcf).
2. Reinforcing steel shall be ASTM A615 with a yield stress, F_y, of 60,000 pounds per square inch (psi).
3. Vertical reinforcing bars shall be placed between 1-1/2 and 2-1/2 inches from the inside face of the
4. Minimum concrete stregnth,f'_c, shall be 3,000 pounds per square inch (psi).
5. Maximum height of soil against foundation walls is 6 inches below top of wall.
6. Refer to Figure 3 for basement wall detail.
7. Refer to Figure 4A for reinforcing at wall corners.
8. Refer to Figure 4B for reinforcing at openings in walls.
9. Minimum length of perpendicular wall shall be 2 feet. Perpendicular wall shall be the same thickness and reinforcing as wall it supports, and may be up to 1'-0" less in height than foundation wall. Perpendicular walls must be placed on minimum 1'-8" strip footing placed integral with foundation wall footing.

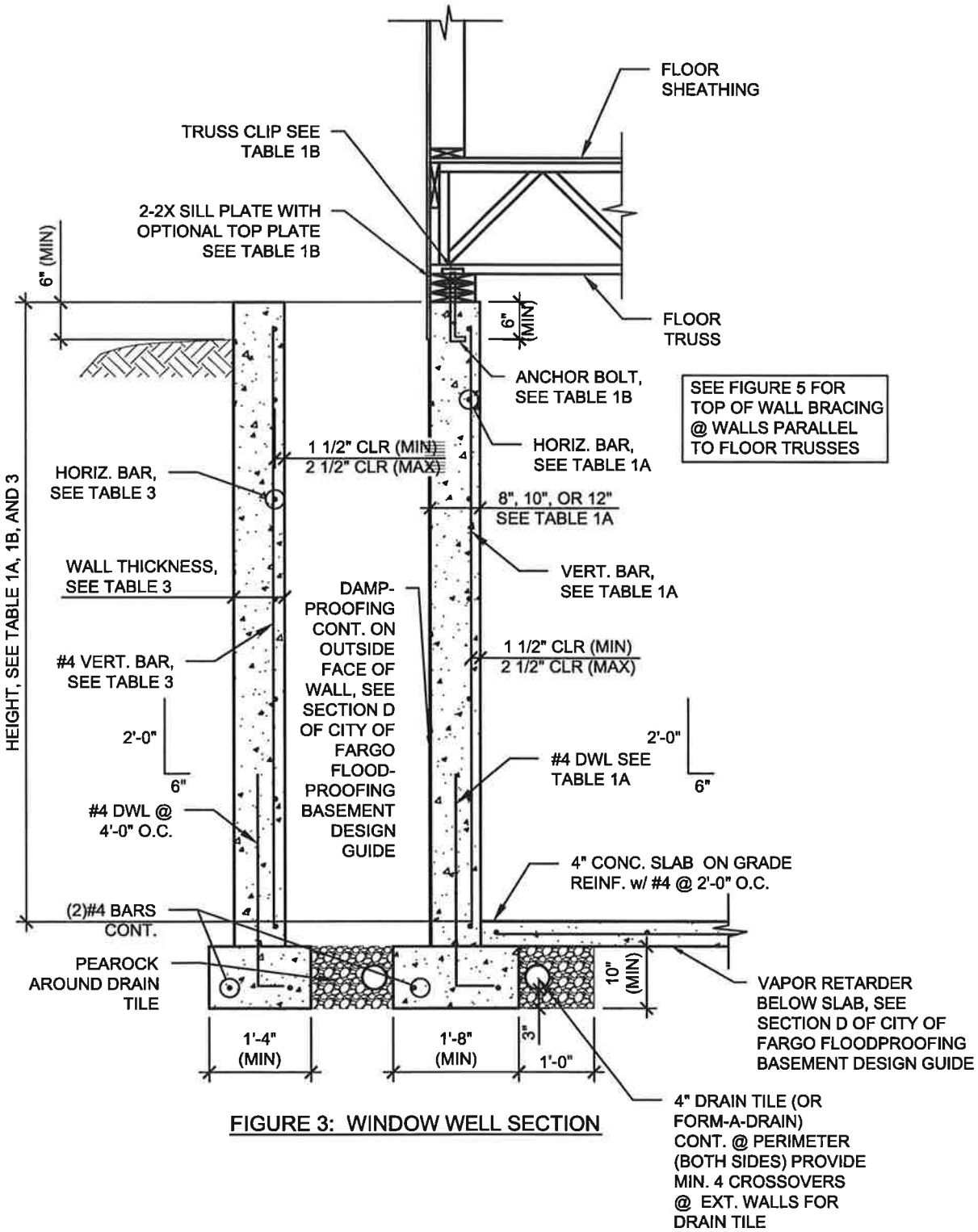
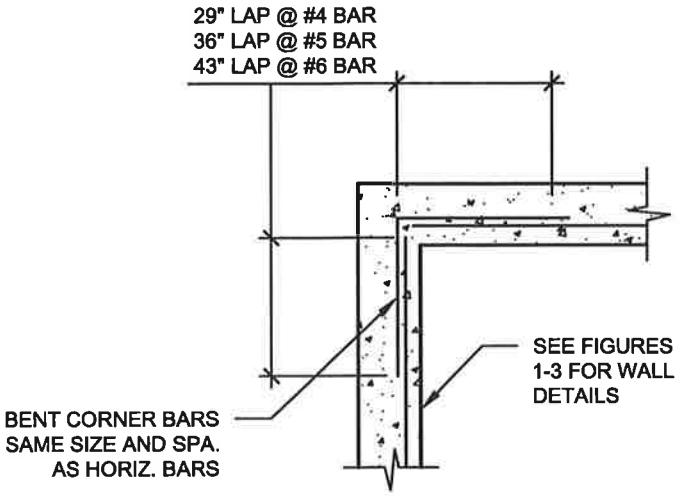


FIGURE 3: WINDOW WELL SECTION



OR

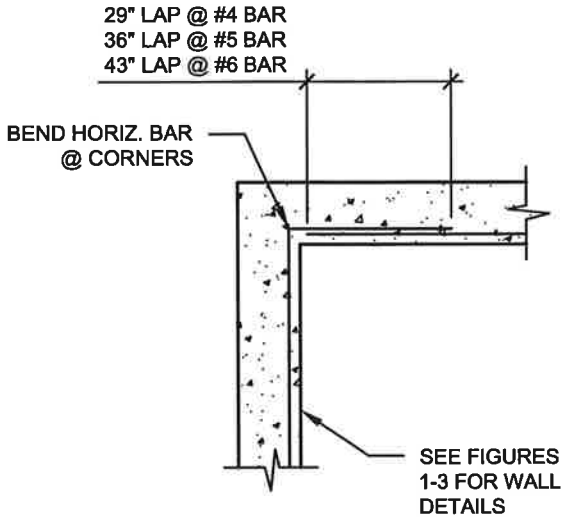


FIGURE 4A: TYP. CONC. WALL CORNER

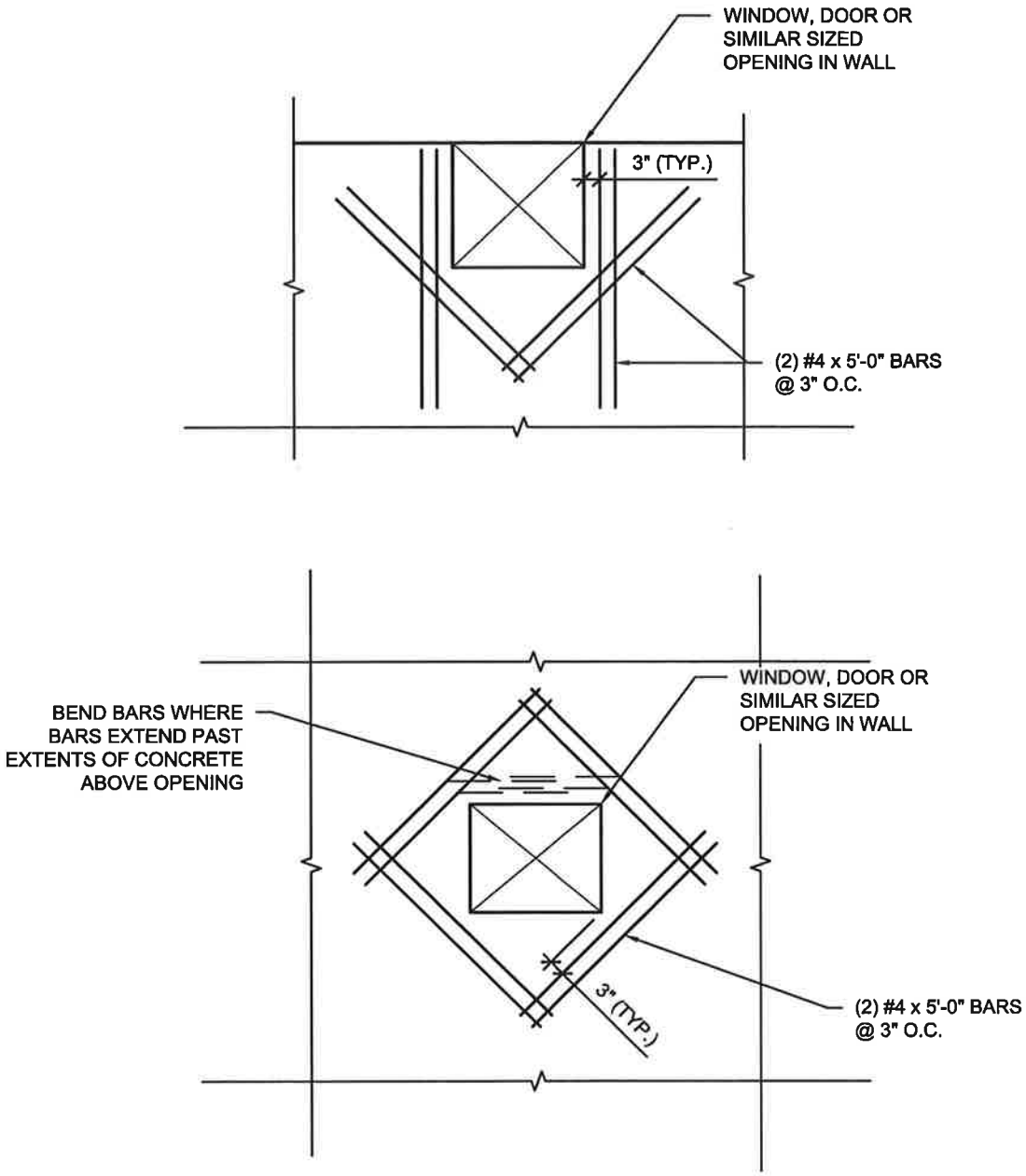
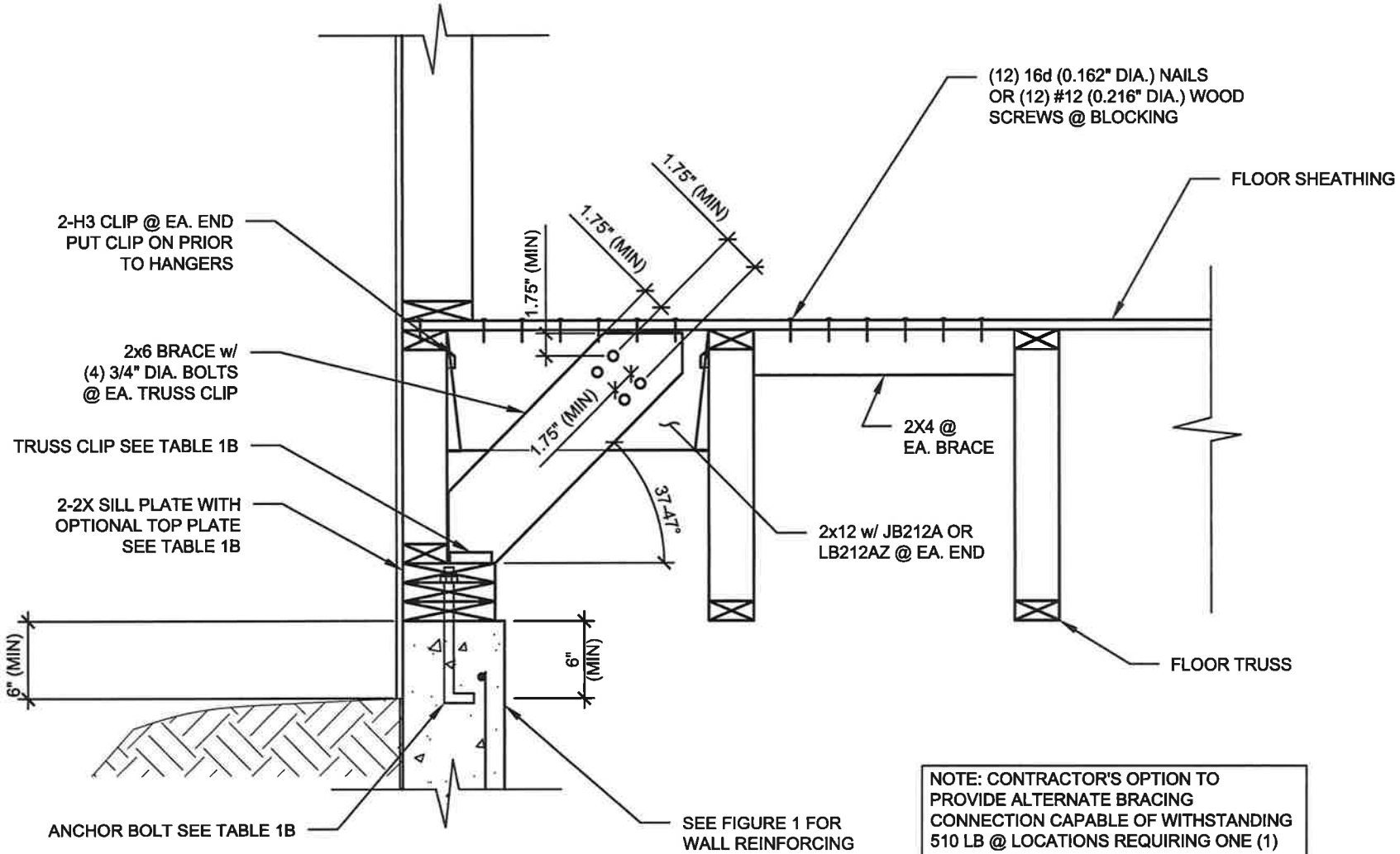


FIGURE 4B: REINFORCING @ WALL OPENINGS



NOTE: CONTRACTOR'S OPTION TO PROVIDE ALTERNATE BRACING CONNECTION CAPABLE OF WITHSTANDING 510 LB @ LOCATIONS REQUIRING ONE (1) TRUSS CLIP AND 1020 LB @ LOCATIONS REQUIRING TWO (2) TRUSS CLIPS. DESIGN MUST BE STAMPED AND SIGNED BY AN ENGINEER REGISTERED IN THE STATE OF NORTH DAKOTA.

FIGURE 5: PARALLEL WALL BRACING

APPENDIX C

INSPECTION LOG FOR FOUNDATIONs

Fargo Inspections

City of Fargo
200 Third Street North
701-241-1561 phone
701-476-6779 fax

FLOOD PROOFING INSPECTION CARD*

Owner: _____

Address: _____

100 Year Flood Elevation: _____ Flood Protection Elevation: _____

Elevation Certification "Flood Protection Elevation"

Point of Risk: _____

Inspector: _____ Date: _____

1. Footing Date: _____ Inspector: _____
   Comments: _____
2. Foundation Date: _____ Inspector: _____
   Comments: _____
3. Waterproofing Date: _____ Inspector: _____
   Comments: _____
4. Drain Tile Date: _____ Inspector: _____
   Comments: _____
5. Sewer Line Date: _____ Inspector: _____
   Comments: _____
6. Sewer Valve Date: _____ Inspector: _____
   Comments: _____
7. Concrete Floor Date: _____ Inspector: _____
   Comments: _____

CITY OF Fargo

APPENDIX D

FEMA RESIDENTIAL
FLOODPROOFING CERTIFICATE

Department of Homeland Security Federal Emergency Management Agency **RESIDENTIAL BASEMENT FLOODPROOFING CERTIFICATE**	*See Reverse Side for Paperwork Burden Disclosure Statement*	O.M.B. No. 1660-0033 Expires August 31, 2013

For use ONLY in communities that have been granted an exception by FEMA to allow the construction of floodproofed residential basements in Special Flood Hazard Areas.

BUILDING OWNER'S NAME	**FOR INSURANCE COMPANY USE** Policy Number
BUILDING STREET ADDRESS *(Including Apt., Unit Number)*	Company NAIC Number
OTHER DESCRIPTION *(Lot and Block Numbers, etc.)*	

CITY	STATE	ZIP CODE

SECTION I – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

provide the following from the FIRM and flood profile *(from Flood Insurance Study)*

COMMUNITY NUMBER	PANEL NUMBER	SUFFIX	DATE OF FIRM	ZONE	BASE FLOOD ELEVATION (IN AO ZONES, USE DEPTH)	NAME OF FLOODING SOURCE(S) AFFECTING BUILDING

SECTION II – FLOODPROOFING INFORMATION *(By a Registered Professional Engineer or Architect)*

Floodproofing Design Elevation Information:

Building is floodproofed to an elevation of _____. ____feet.
(Elevation datum used must be the same as that on the FIRM.)

Elevation of the top of the basement floor is _____. ____feet.
(Note: The floodproofing design elevation must be at least one foot above the Base Flood Elevation [BFE])

SECTION III – CERTIFICATION *(By a Registered Professional Engineer or Architect)*

Residential Floodproofed Basement Construction Certification:

I certify that, based upon development and/or review of structural design specifications, and plans for construction, including consideration of the depth, velocity, and duration of flooding and the type and permeability of soils at the site, the design and methods of construction of the floodproofed basement to be used are in accordance with accepted standards of practice for meeting the following provisions:

- Basement area, together with attendant utilities and sanitary facilities, is watertight to the floodproofing design elevation with walls that are impermeable to the passage of water without human intervention; and
- Basement walls and floor are capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy resulting from flooding to the floodproofing design elevation; and have been designed so that minimal damage will occur from floods that exceed the floodproofing design elevation; and
- Building design, including the floodproofing design elevation, complies with community requirements.

I certify that the information on this certificate represents my best efforts to interpret the data available. I understand that any false statement may be punishable by fine or imprisonment under 18 U.S. Code Section 1001.

CERTIFIER'S NAME		LICENSE NUMBER *(or affix Seal)*	
TITLE	COMPANY NAME		
ADDRESS	CITY	STATE	ZIP
SIGNATURE	PHONE NO.		DATE

Copies of this certificate must be given to: 1) the community official; 2) the insurance agent; and 3) the building owner.

PAPERWORK BURDEN DISCLOSURE STATEMENT

Residential Basement Floodproofing Certificate

FEMA Form 086-0-24

Public reporting burden for this data collection is estimated to average 3.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and submitting this Residential Basement Floodproofing Certificate. You are not required to respond to this collection of information unless a valid OM B control number is displayed in the upper right corner of this Residential Basement Floodproofing Certificate.

Send comments regarding the accuracy of the burden estimate and any suggestions for reducing the burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472, Paperwork Reduction Project (1660-0033) **NOTE: Do not send your completed form to this address.**

CITY OF Fargo

APPENDIX D

FEMA NON-RESIDENTIAL FLOODPROOFING CERTIFICATE

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
National Flood Insurance Program

FLOODPROOFING CERTIFICATE
FOR NON-RESIDENTIAL STRUCTURES

OMB No. 1660-0008
Expiration Date: July 31, 2015

The floodproofing of non-residential buildings may be permitted as an alternative to elevating to or above the Base Flood Elevation; however, a floodproofing design certification is required. This form is to be used for that certification. Floodproofing of a residential building does not alter a community's floodplain management elevation requirements or affect the insurance rating unless the community has been issued an exception by FEMA to allow floodproofed residential basements. The permitting of a floodproofed residential basement requires a separate certification specifying that the design complies with the local floodplain management ordinance.

BUILDING OWNER'S NAME

STREET ADDRESS (Including Apt., Unit, Suite, and/or Bldg. Number) OR P.O. ROUTE AND BOX NUMBER

OTHER DESCRIPTION (Lot and Block Numbers, etc.)

CITY STATE ZIP CODE

SECTION I – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

Provide the following from the proper FIRM:

COMMUNITY NUMBER	PANEL NUMBER	SUFFIX	DATE OF FIRM INDEX	FIRM ZONE	BASE FLOOD ELEVATION (In AO Zones, Use Depth)

Indicate elevation datum used for Base Flood Elevation shown above: ☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: _____

SECTION II – FLOODPROOFING INFORMATION (By a Registered Professional Engineer or Architect)

Elevations are based on: ☐ Construction Drawings ☐ Building Under Construction ☐ Finished Construction

Floodproofing Design Elevation Information:

Building is floodproofed to an elevation of ____ . ____ feet (In Puerto Rico only: ____ . ____ meters). ☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: _____
(Elevation datum used must be the same as that used for the Base Flood Elevation.)

Height of floodproofing on the building above the lowest adjacent grade is _____ feet (In Puerto Rico only: _____ meters).

For Unnumbered A Zones Only:

Highest adjacent (finished) grade next to the building (HAG) ____ . ____ feet (In Puerto Rico only: ____ . ____ meters)

☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: _____

(NOTE: For insurance rating purposes, the building's floodproofed design elevation must be at least 1 foot above the Base Flood Elevation to receive rating credit. If the building is floodproofed only to the Base Flood Elevation, then the building's insurance rating will result in a higher premium.)

SECTION III – CERTIFICATION (By a Registered Professional Engineer or Architect)

Non-Residential Floodproofed Construction Certification:

I certify that, based upon development and/or review of structural design, specifications, and plans for construction, the design and methods of construction are in accordance with accepted standards of practice for meeting the following provisions:

The structure, together with attendant utilities and sanitary facilities, is watertight to the floodproofed design elevation indicated above, with walls that are substantially impermeable to the passage of water.

All structural components are capable of resisting hydrostatic and hydrodynamic flood forces, including the effects of buoyancy, and anticipated debris impact forces.

I certify that the information on this certificate represents my best efforts to interpret the data available. I understand that any false statement may be punishable by fine or imprisonment under 18 U.S. Code, Section 1001.

CERTIFIER'S NAME LICENSE NUMBER (or Affix Seal)

TITLE COMPANY NAME

ADDRESS CITY STATE ZIP CODE

SIGNATURE DATE PHONE

Copies should be made of this Certificate for: 1) community official, 2) Insurance agent/company, and 3) building owner.

National Flood Insurance Program

FLOODPROOFING CERTIFICATE

FOR NON-RESIDENTIAL STRUCTURES

Paperwork Reduction Act Notice

General: This information is provided pursuant to Public Law 96-511 (the Paperwork Reduction Act of 1980, as amended), dated December 11, 1980, to allow the public to participate more fully and meaningfully in the Federal paperwork review process.

Authority: Public Law 96-511, amended; 44 U.S.C. 3507; and 5 CFR 1320.

Paperwork Burden Disclosure Notice: Public reporting burden for this data collection is estimated to average 3.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and submitting this form. You are not required to respond to this collection of information unless a valid OMB control number is displayed on this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing the burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0008). **NOTE: Do not send your completed form to this address.**

Privacy Act Statement

Authority: Title 44 CFR § 61.7 and 61.8.

Principal Purpose(s): This information is being collected for the primary purpose of estimate the risk premium rates necessary to provide flood insurance for new or substantially improved structures in designated Special Flood Hazard Areas.

Routine Use(s): The information on this form may be disclosed as generally permitted under 5 U.S.C. § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA-003 – National Flood Insurance Program Files System or Records Notice 73 Fed. Reg. 77747 (December 19, 2008); DHS/FEMA/NFIP/LOMA-1 – National Flood Insurance Program (NFIP) Letter of Map Amendment (LOMA) System of Records Notice 71 Fed. Reg. 7990 (February 15, 2006); and upon written request, written consent, by agreement, or as required by law.

Disclosure: The disclosure of information on this form is voluntary; however, failure to provide the information requested may result in the inability to obtain flood insurance through the National Flood Insurance Program or may be subject to higher premium rates for flood insurance. Information will only be released as permitted by law.