Mahaley Odell Thompson
ARCHITECT

March 28, 2011

Chuck Wooten
County Manager
401 Grindstaff Cove Road, Room A207
Sylva, NC 28779

Dear Mr. Wooten,

Per the request of former Planning Director Gerald Green, Owen Rothberg, structural engineer, and I visited the 1960 Drexel Building in Whittier to assess the condition of the building and the adjacent water tower for reuse by the county. In my discussions with Gerald, it was decided that the structural conditions of the building and the water tower were the most important components of this assessment given that almost all of the electrical system has been stolen and damaged by vandals, and the visible components of the plumbing system have been stolen or damaged by vandals. In our opinion, the most costly potential modifications would be the structural modifications that might be required to make this building safe for future, different uses. This assessment is not intended to define a precise scope of remedial work, because we do not know yet how the building will actually be used. Different uses may require different degrees of modifications. A building of this size (over 82,000 SF) is bound to have a variety of different, new uses.

I have summarized my assessment here of the architectural aspects of this building, and I have attached Owen's assessment of the structural systems.

Physical Features:

Exterior Walls: The exterior walls are mostly 12" thick brick walls which surround the entire building except for the metal siding on the extreme northwest end of the structure at the kiln area. Most of these walls are not supporting roof loads, but are merely providing the weather resisting exterior envelope to the structure. They do not have thermal insulation. They are in surprisingly good condition with only a few instances of cracking and a few holes which were cut through the brick to route pipes or other utilities. There are many locations where vines have begun to grow on the walls and up to the roof. This plant life must be removed to protect the building from deterioration. Similarly, there are locations where downspouts have disappeared, and the water has been directed onto the brick walls which are showing signs of rust (from the roofing). The downspouts should be replaced to keep the collected water away from the brick walls.

Doors in Exterior Walls: Most of the hinged man doors in the exterior brick walls are functional, and could be re-used. Most of the overhead doors and large rolling doors are damaged beyond repair, and will need to be replaced or abandoned depending on the future use of the building.

Slab: The concrete slab is in excellent condition. It was poured originally in 40 foot sections, and these sections show minimal signs of cracking that one might expect in a 4" thick concrete slab. It is a testament to the quality of the original concrete material and the workmanship of the installers.

Ceiling: The roof/ceiling is a typical metal building roof with metal building roofing insulation. In the main factory spaces, there is no finished ceiling below the exposed structure. In the bumped-out office wing on the north side of the building, there is a suspended acoustical ceiling, but it is damaged beyond reuse.

Roof: The majority of the structure is roofed with a metal roof that appears to be original to the building (55 years old now). The roofing panels are in tact but show considerable signs of rust, and in numerous locations throughout the building, have leaked and will continue to leak. The roof over the office bump out is in particularly poor condition, and should be replaced if any use is planned for the space below. The roof over the northern end of the building is newer, and is probably worth keeping. As the rusting roofing has outlived its 50 year life expectancy, should the County decide to reuse this building, I would recommend replacing the roofing wherever new interior space must be kept dry. At about $10 per square foot to replace the roofing, the cost to replace the +/- 75,000 SF of rusted roof could approach $750,000. As a note, if the county has any intentions of installing solar panels on this huge roof, the old roofing should be replaced with new roofing first.

Gutters and downspouts: The original gutters exist along each of the long sides of the structure, but many of the downspouts are missing. Evidence of rust on the exterior brick walls highlights where the downspouts are missing. The condition of the gutters is expected to be consistent with the roofing, and should most likely be replaced if/when the roof is replaced. The original 4" downspouts were spaced at about 40 feet on center. This is not adequate for our potential 100 year rain events, and I would recommend increasing the size and/or number of downspouts to handle the heaviest rain events. Each downspout will need to be routed in pipes to a lower part of the site away from the structure.

Electrical System: Most of the copper wiring has been removed from the structure by vandals, so from a practical standpoint, a completely new electrical distribution system will be required. Unknown damage at the panels would necessitate new electrical panels and subpanels throughout. Per the Master plan prepared by Altamont Environmental, any new electrical system should be installed with the flood level in mind so that when the building floods, the electrical system is above the flood water. Numerous mercury vapor lights are still in place in the main volume of the building. They could be evaluated for reuse if/when the building is remodeled; however, to comply with the current energy code, alternate lighting would be recommended.

Mechanical Systems: Radiant space heaters were used in the factory area, and a small split system appears to have been installed for the office space. The condition of the unit is unknown due to lack of electricity, but if/when this building is remodeled, it can be evaluated for reuse.

Plumbing: There are several single toilet restrooms within the factory space, but each is elevated several steps up to provide for the slope of the drain lines which appear to be above the original concrete slab. The fixtures have been vandalized and are not suitable for re-use. The restrooms in the office space may be re-used, but will need to be modified by replacing fixtures and adding more fixtures to provide for accessibility and for the greater number of occupants, and thus fixtures, proposed in the master plan.

Fire Suppression: There is an existing fire suppression system that is connected to the water tower at the east end of the building. The condition of the pipes and sprinkler heads is unknown as the water tower is empty and the pipes have been dry for some time. If/when the building is remodeled, the condition of the pipes and heads should be verified. Depending on the future uses and space layouts, the sprinkler head locations will need to be modified anyway to comply with the current NFPA requirements.

Building Code Considerations:

As this is an existing building, we may utilize the North Carolina Rehabilitation Code which allows for reusing structures that were built under previous codes that might not meet all of the requirements contained in the current building code. In this case, the Drexel building contains over 82,000 SF of interior space- much of it contiguous and non-separated. It was built as a factory which would be classified under today's code as an **F-1 Occupancy**. Per the master plan, the future potential uses include:

Main Entrance/ Offices = **B Occupancy**

Market Space (farmers' market, auto shows, tractor shoes) = **M or A-3 Occupancy**

Event Space (concerts, gatherings, weddings, etc.) = **A-3 Occupancy**

Classroom/ Educations Space = **B Occupancy**

Storage Space (materials and vehicles) = **S-2 Occupancy**

The Rehabilitation Code relies on comparing the future use(s) with the original use to determine if the new use(s) is (are) more hazardous than the original use. If the new use is not more hazardous, then, in general, it may be allowed to exist in the original space. The criteria outlined in the Rehab Code for comparing the relative hazard classifications of the original and proposed uses include:

Relative Use Group - Table B. The proposed uses are not a greater hazard than the original use.

Means of Egress - Table C. Only the A-3 Occupancy is a greater hazard classification than the original use. Therefore, all A-3 Occupancies must comply with the current NC State Building Code as they relate to the requirements for exiting found in Chapter 10 of the Code.

Height and Area - Table E. The proposed uses are not of greater hazard than the original use in this category, therefore the current height and area requirements are not applicable

Exposure of Exterior Walls- Table F. The proposed uses are not of greater hazard than the original use in this category; therefore, the existing conditions may remain as is.

Fire Suppression- Table G. Only the A-3 Occupancies are of greater hazard classification than the original use. All A-3 Occupancies must comply with the requirements of Section 903.2.1 for NFPA fire suppression systems. Note that the existing fire suppression system may comply or come close to complying with this requirement. The Rehab Code does allow for bringing only the sprinkler system for the A-3 Use Group areas up to current codes as long as they are separated from other use groups by approved fire walls.

Structural Load Categories- Table K. The proposed uses are not of greater hazard categories than the original use; however, when the building is occupied by 300 or more people in an A-3 Use Group such as a music performance or some type of show, then the building will be considered to be in a Seismic Use Group III, and must comply with the requirements in the current code, section 1613. This is why the structural calculations in Owen's report show that the structural steel frames and base plates must be upgraded- to withstand the potential seismic forces so as to protect a great many people who might be in this building when we get the big one.

Accessibility- Because the proposed new uses will inhabit more than 10,000 SF of space, the entire facility must comply with the current accessibility codes.

Summary:

From our evaluations, the building is in surprisingly good condition for its age and level of maintenance. Depending on the intended use of the structure, the structural frames will need to be reinforced at the eaves and at the base plates. The roof will need to be replaced. The gutters and downspouts will need to be replaced. The electrical system will need to be replaced with a new, flood-proof system. Much of the plumbing will need to be re-done and augmented. A new HVAC system will need to be designed and installed to serve any spaces requiring conditioned air. The fire suppression system will most likely need to be updated, repaired, and/or replaced. Accessible routes will need to be provided into and throughout the building.

Any of these upgrades and modifications must be considered with knowledge that this building is not only in the flood plane, but it is in the flood way. When the levee fails in the future, this building will be in the flow path of the river, and it will sustain damage from the force of flowing water and water borne debris. Whatever work is done to this building should be done with that in mind. If we anticipate the worst, and design the proposed systems and structure to survive the worst, then the repairs after the event will be minimized.

Should you have any questions about this assessment, please let me know.

Sincerely,

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May 30, 2015

EVALUATION OF THE STRUCTURE OF THE DREXEL PLANT BUILDING AND WATER TOWER AT 294 CLEARWOOD DRIVE, WHITTIER, NC

1. PURPOSE:

   a. The purpose of this study was to assess the suitability of the existing building structure and existing water tower structure to satisfy the purposes described in the "Smoky Mountain Agricultural Development Master Plan" dated December 1, 2014, prepared for Jackson County by Altamont Environmental Inc., Asheville, NC.

   b. The following report describes the results of an investigation made by Owen Rothberg, P.E. of O&M Associates, PLLC to assess the structural capacity of the existing building structure and the existing water tower structure.

2. SCOPE:

   a. Building Structure Evaluation.
      i. Steel building frames.
      ii. Roof and secondary roof framing.
      iii. Brick walls.
      iv. Building foundation.
      v. Office structure

   b. Water tower structure evaluation.
      i. Water tower supports.
      ii. Water tower foundation.
      iii. Water tank.

   c. Summary and conclusions.

   d. No geotechnical investigation was conducted. No loading caused by flooding was considered.

3. BUILDING STRUCTURE EVALUATION:

a. Description.

i. The building is approximately 800 feet long by 100 feet wide. A rectangular office space appends the approximate center of the length of the building. The roof is corrugated sheet metal with a low slope to the peak. The roof is supported by longitudinal six inch deep "Z" purlins at about 3.5 feet on centers. The outside walls are 1 foot thick brick.

ii. The building concrete floor is approximately four feet above grade in portions of the building providing loading-dock access to a number of sliding doors. Other portions of the building are at grade. The slab is flat and measures four inches thick at one cut-out in the South-East end of the building. The floor slab appears to be in good condition with few cracks.

iii. The main support for the roof consists of steel tapered-member building frames spanning the full width of the building and equally spaced at twenty feet on centers. The longitudinal and transverse brick walls also provide substantial support for the roof in both the lateral and longitudinal directions.

iv. There are two interior transverse brick walls at the South-East end of the building. Each of these has large, steel-framed openings. A brick drying kiln structure occupies the North-West end of the building with several interior walls running in each direction.

v. The transverse steel building frames are laterally supported by the roof, intermittent round-bar braces between the frames, strap braces between the roof and the frame lower flanges at various points along the frame span, and the outside walls at the flanges of the vertical members. The straps and braces appear to be in good condition.

b. Steel Building Frames.

i. The main focus of the structural analysis was on the building frames because these structural elements provide most of the main support for the building roof and are one of the primary components of the lateral force resisting system..Other components of the roof support are the brick wall structures.

ii. The steel frames are 16 feet high at the eaves and 22 feet high at the ridge. The frame cross sections vary along their length from 13 inches deep to 36 inches deep. The outside flanges are 6x½ flat bars and the inside flanges are 6x¾ flat bars (where measured). The webs are ¼ inch thick.

iii. The frames are braced at the top flange by the purlins and angle braces spanning between the frames. The bottom flanges are braced with steel strap braces. No distortion or damage to the bracing was observed. The material of the braces does not appear to be rusted or deteriorated.

iv. The mechanical properties of the steel material are unknown. Steel with a yield strength of 36,000 pounds-per-square-inch (36 ksi) was assumed for all steel material. This value remains to be verified by chemical and/or mechanical testing.

v. Overall, the frame steel material was observed to be in good condition with almost no flaking rust. Some light rust was observed at the bases of the frames at the concrete floor but this was considered minor.

vi. An analysis of a typical transverse frame was performed. The stresses at the eaves were found to be at yield stress (assuming 36 ksi), thus providing a factor-of-safety equal to one, where 1.6 would be required. <u>This condition must be addressed in order for the building to be considered acceptable for use as an assembly facility.</u> Additional brackets and or doubler plates can be added to the frames at each corner (70 corners) to resolve this condition.

vii. The anchor bolts for the frames are overloaded in shear (about double allowable), assuming 36 ksi steel and one inch diameter bolts. It may be that the strength of the anchor bolt material was underestimated but if not, the connections at the slab will have to be reinforced. The strength of the anchor bolt material will have to be verified by testing. <u>This condition must be addressed in order for the building to be considered acceptable for use as an assembly facility.</u> An addition to each of the existing base plates can be welded on and two added anchor bolts can be installed in the existing pier at each base plate. There are 70 base plates to be modified.

viii. One solution to the overload problems in the frames and anchor bolts would be to add a center column to each of the frames (35 frames).
  (1) The cost would have to be estimated and compared with the cost of the frame and anchor bolt material verification and modifications suggested in items vi and vii above.
  (2) My opinion is that adding the columns would be comparable in cost, easier to install, and would result in a much more competent structure. The stresses in the frames would be substantially reduced and the overload condition in the anchor bolts would be resolved.
  (3) This solution would, of course, have to satisfy the architectural considerations for the future use of the building.

c. Roof and Secondary Roof Framing

i. The roof steel material appears to be in poor condition judging from the color and apparent distortion of the roof sheets as observed from the ground, especially in the area over the office which is almost flat.
  (1) This roof serves as a diaphragm to tie together the main lateral bracing systems for the building.
  (2) The roof diaphragm was not assessed in detail as a structural member in this analysis because the material thickness, material properties, and fastening details of the roofing are unknown at this time.

(3) The roof membrane of this long building provides an important redundant lateral bracing structure and its contribution to the overall structural capacity of the building dictates that it should be inspected in detail, repaired and then maintained.

ii. Secondary roof framing consists of six inch deep "Z" purlins spaced at 3'-6" on centers and running longitudinally for the full length of the roof. The purlins appear to be cold-formed steel.

(1) The purlins appear to be in good condition although the top flanges could not be observed because they are in direct contact with the roof insulation. No deflection or distortion of the purlins was observed.

(2) The purlins were analyzed for strength assuming 36 ksi for the material strength. This would be a conservative assumption for cold-formed steel. Based on the properties of a Z6x5.1 (6 inches deep and weighing 5.1 pounds-per-foot) the bending stresses were found to be acceptable. The assumptions regarding cross section properties and material remain to be verified.

d. Brick Walls

i. In general, the brick walls are twelve inches thick and appear to be of uniform size. The properties of the brick are unknown. The outside walls are brick to the eaves. The North-West brick wall is topped with a heavy truss and has two large openings at the center. Two transverse brick walls are in the interior of the building and run floor to roof. Roof purlins are fastened to the brick walls with steel angle ledgers. The brick wall were assumed to be unreinforced.

ii. The drying kilns are a brick structure at the South-East corner of the building. These are all brick and could be characterized as heavy brick construction.

iii. All of the brick walls appear to be in good condition. No large or "stair-step" cracks were observed.

iv. The brick walls serve as lateral bracing for the vertical portions of the steel building frames, although the method of attachment of the brick to the vertical portions of the frames was not observable. Usually, crossed rod bracing is used to provide lateral restraint but few vertical cross braces were observed and thus it was concluded that the brick walls serve as lateral bracing and shear walls for the building.

v. Although the lateral shear resistance of the walls was not calculated because the composition, construction and material of the brick is unknown and will require testing, the brick walls appear to have served well and major upgrades, repairs or modifications probably will not be necessary.

e. Building Foundation

i. The building steel frames appear to have been placed on concrete piers, of varying horizontal dimensions, some measuring about 24 by 30 inches at the tops and some less.

ii. The configuration of the piers, reinforcing, overall height, foundation attachment, and attachment to the slab, if any exists, is unknown.

iii. The construction of the building foundation was not visible and will require some demolition around the foundation and pier structures (and possibly non-destructive testing) in order to determine the configuration and composition. Only the tops of the piers could be observed and these appeared to be in good condition.

iv. The configuration of the piers and their foundations is critical to an understanding of how the steel building frames are supported, given the high horizontal loads imposed by the steel building frames on the tops of the piers, Demolition will be necessary to determine the characteristics of the piers and footings, and will require repairs to the brick, floor slab, and outside walls in at least two places.

f. Office Structure

i. An office structure is appended to the outside of the main building. This structure is constructed with a very low-pitch metal roof , purlins similar to the main building, two deep tapered steel girders running parallel to the main building frames (but not attached directly to the building frames), brick outside walls and a slab-on-ground. The foundation structure is unknown and could not be observed. Large glass store-front-type windows exist on the East side of the building, directly below the main roof girders.

ii. The tapered steel girders rest on the longitudinal brick walls of the main building at one end and over the glass store front at the other end. The support for the girders could not be observed but heavy steel lintels would have had to be enclosed in the wall to provide the necessary support. This remains to be confirmed along with the condition of the lintels and their capability to serve under current loading requirements.

iii. The office structure roof slope is almost flat and in poor condition.

iv. <u>Proper support must be confirmed for the existing office roof girders.</u> The current support structure at the interior and exterior walls (especially above the windows) is unknown and demolition will be required in order to determine if the supports are acceptable. If the support structure is not acceptable, structural modifications of unknown scope will be required.

4. WATER TOWER EVALUATION

a. Description

i. The water tower was used for fire suppression when the plant was in use.

ii. The tank is a double ellipsoid supported on four pipe columns with horizontal braces at the third points of the height and 1½ diameter bar "X" braces on all four sides. A catwalk runs around the circumference of the tank at the tops of the pipe columns. A 3 foot diameter vertical pipe which was assumed, for the purposes of analysis, to be a non-structural member is centered on the tank bottom.

iii. According to the label plate attached to the center column, the tower was built by Brown Steel Contractors, Inc. of Newnan, Georgia in 1964. The contractor appears to be no longer in business. The capacity of the tank is 75,000 gallons and the bottom of the tank is 100 feet above the base (which was not defined).

iv. Each of the tower legs is fastened to a three foot square concrete pier with two 1¼ inch diameter threaded steel anchor bolts.
   (1) The length of the bolts embedded in the concrete pier is unknown. The piers are about four feet high and rest on nine foot square footings.
   (2) There is also a footing below which projects about 4½ feet from the edge of the nine-by-nine footings. The size and thickness of this lower footing was not clearly determined during the excavation, however it appears to run around the perimeter of the water tower. If that is correct the outside dimensions of the lower footing would be about 45 feet square, which would provide sufficient dead weight to preclude overturning moments produced by the loads imposed by the North Carolina Building Code.

v. The soil above the footings was quite soft and easily excavated. Ground water was encountered about six feet below grade and the ground appeared to be harder at that level. No geotechnical investigation was done.

vi. The tower structure appears to be in good condition. This observation should be confirmed by a detailed inspection. The tank piers and foundations appeared to be in good condition although some cracking was noted in the center concrete structure that supports the (assumed non-structural) center vertical pipe.

The extent and condition of the foundation should also be surveyed to confirm its extent and depth.

vii. Research is ongoing in an effort to obtain more information about the tower and tank from another source. The objective is to obtain drawings, specifications, and calculations.

viii. Assumptions and estimates used in constructing a mathematical model of the water tower for a stress analysis to determine if the tower is overloaded using current building code criteria, were as follows:

(1) The tower was estimated to be 120 feet high from ground to top and the center of the tank (top of main support legs) is 110 feet from the tops of the piers.
(2) The legs were measured to be 15 inches in diameter and were modeled as ½ inch thick 36 ksi steel.
(3) The weight of the tank and water was estimated to be 650,000 pounds (650 kips). This was divided equally among the four vertical legs and at the intersection of two "dummy" stiff cross members at the geometric center of the tower and tank.
(4) Wind and seismic loads were conservatively assumed to be centered 110 feet above the base of the tank.
(5) The horizontal struts were modeled as members stiff enough to withstand the imposed compression loads without buckling. The rod braces were modeled as tension-only members.
(6) The horizontal struts, inclined rod braces, and anchor rods were assumed to have a yield strength of 36 ksi.
(7) For the purposes of this analysis, the tank and support structure were assumed to be in good condition.

ix. A structural analysis was performed using the criteria described above. The tank was not included in the model. Dummy members of sufficient stiffness were placed at the top of the tower model. The water tower structure appears to be capable of withstanding the loads imposed by wind and gravity loads. However, the anchor bolts at the base of the tower are overloaded under a combination of seismic load and a partially filled tank, It remains to be determined if the anchor bolts were made of stronger steel (36 ksi yield) than assumed..

(1) One conservative assumption was that the center column (water pipe) does not contribute to the structural load bearing capacity of the tower. This assumption remains to be verified.

5. SUMMARY AND CONCLUSIONS

a. The building structure is useable with the following modifications and conditions:

i. The material of the steel building frames must be determined. If the material is 36 ksi steel, the frames will have to be reinforced at the eave corners. The steel bent frames must be reinforced with welded brackets and/or doubler plates at each corner. Refer to paragraph 3.b.vi, above.

ii. The anchorage for the steel building frames must be augmented (assuming 36 ksi anchor bolts which must be established by testing). The base material will have to be welded to the existing and two additional anchor bolts will have to be installed at each base plate. Refer to paragraph 3.b.vii, above.

iii. As an alternative to the recommendations described in items I. and ii, above, a center column could be added to the building steel frames and this column will provide the necessary support for the frames. Refer to paragraph 3.b.viii, above.

iv. The foundation structure for the building must be excavated and shown to be of acceptable size and condition.

v. The roofing must be surveyed and repaired.

vi. The supports for the roof girders of the office area must be exposed and found to be capable of withstanding current load requirements.

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b. The water tower is useable with the following modifications and conditions:

   i. The anchor bolts must be positively determined to be made of stronger material than assumed or additional anchor bolts must be added at each corner column.
      (1) The assumptions and estimates used in the tower structural analysis should be reviewed if additional information about the design of the tower is obtained.

   ii. The footings for the water tower need to be investigated further in order to confirm the estimates (based on the current limited excavation conducted recently) that the foundation structure is of adequate size and acceptable condition.

   iii. A survey should be conducted to determine if the tank itself is in serviceable condition and if any of the tower structure components are in need of repair or replacement.

c. Illustrations of the computer models used in the analyses are appended on the following sheets.

END