Appendix F

Combined Phase IA-IB Sensitivity Assessment

PHASE I ARCHAEOLOGICAL SENSITIVITY ASSESSMENT AND INTENSIVE ARCHAEOLOGICAL INVESTIGATION NATIONAL GRID, NEW C203 230KV TAP LITTLETON (GRAFTON COUNTY), NEW HAMPSHIRE

Submitted to

Mr. Joshua Holden
National Grid
40 Sylvan Road
Waltham, MA 02451

Kathleen Wheeler, Ph. D., Principal Investigator

Prepared by

Kathleen Wheeler, Ph. D.
and Ellen Marlatt, M.A.

www.iac-llc.net

IAC Report No. 1112
October 8, 2013
Final Report: October 25, 2013

PROJECT SUMMARY

Project Name(s):	National Grid, New C203 230kv Tap
Type of Survey:	Combined Phase IA-IB sensitivity assessment and intensive archaeological investigation
Client:	National Grid & Vanasse Hangen Brustlin, Inc.
Sponsor Agency:	NH Site Evaluation Committee; NH Department of Environmental Services; US Army Corps of Engineers
Location:	Littleton Substation, Littleton, Grafton County, New Hampshire
Project Area Size:	Approximately 3.5 acres
Expected Impacts:	New 230kV tap line from the Littleton Substation to the C203 transmission line, requiring approximately 41 m (135 ft) of new ROW width. Current favored alternative tap location is on west side of current transmission lines.
DHR Site File Search:	July 23, 2013 by Ellen Marlatt of Independent Archaeological Consulting, LLC (IAC)
Dates of Fieldwork:	Phase IA: July 25, 2013 by Kathleen Wheeler and Maya Carter (IAC) Phase IB: September 25, 2013 by Maya Carter and Marika Labash (IAC)
Sites Registered:	None
Findings:	Much of the Project area is upland with steady 6 percent slope that is comprised of wetland with thin, hummocky soil. One small area is sensitive for Pre-Contact archaeological resources, where terrain is relatively level and dry. This sensitive area is the location for a future structure, which will impact an area of approximately 16 m by 16 m (50 ft by 50 ft). IAC conducted Phase I testing here with three shovel test pits, but found no cultural resources.
Recommendations:	We recommend no further archaeological investigation.

No. of pages: 20
No. of Maps: 8
No. of Figures: 0

Appendix G

NHDHR RPR & DOE Memo

Please mail the completed form and required material to:

New Hampshire Division of Historical Resources
State Historic Preservation Office
Attention: Review & Compliance
19 Pillsbury Street, Concord, NH 03301-3570

RECEIVED
OCT 30 2013

DHR Use Only	
R&C #	5226
Log In Date	10/30/13
Response Date	11/12/13
Sent Date	11/13/13

Request for Project Review by the New Hampshire Division of Historical Resources

☒ This is a new submittal
☐ This is additional information relating to DHR Review & Compliance (R&C) #:

GENERAL PROJECT INFORMATION

Project Title **C203 New 230kV Tap at Littleton Substation**

Project Location **266 Foster Hill Road**

City/Town **Littleton** Tax Map **41** Lot # **8**

NH State Plane - Feet Geographic Coordinates: Easting **927112** Northing **667306**
(See RPR Instructions and R&C FAQs for guidance.)

Lead Federal Agency and Contact *(if applicable)* **US Army Corps of Engineers**
(Agency providing funds, licenses, or permits)
Permit Type and Permit or Job Reference # **Clean Water Act, Section 404**

State Agency and Contact *(if applicable)* **NH Site Evaluation Committee**

Permit Type and Permit or Job Reference # **Certificate of Site and Facility**

APPLICANT INFORMATION

Applicant Name **Joshua Holden, New England Power Company - National Grid USA**

Mailing Address **40 Sylvan Road** Phone Number **(781) 907-3648**

City **Waltham** State **MA** Zip **02451** Email **Joshua.Holden@nationalgrid.com**

CONTACT PERSON TO RECEIVE RESPONSE

Name/Company **Peter Walker, VHB**

Mailing Address **6 Bedford Farms Drive** Phone Number **603-644-0888**

City **Bedford** State **NH** Zip **03110** Email **pwalker@vhb.com**

Thank you

This form is updated periodically. Please download the current form at www.nh.gov/nhdhr/review. *Please refer to the Request for Project Review Instructions for direction on completing this form.* Submit one copy of this project review form for each project for which review is requested. Include a self-addressed stamped envelope to expedite review response. Project submissions will not be accepted via facsimile or e-mail. This form is required. Review request form must be complete for review to begin. Incomplete forms will be sent back to the applicant without comment. Please be aware that this form may only initiate consultation. For some projects, additional information will be needed to complete the Section 106 review. All items and supporting documentation submitted with a review request, including photographs and publications, will be retained by the DHR as part of its review records. Items to be kept confidential should be clearly identified. For questions regarding the DHR review process and the DHR's role in it, please visit our website at: www.nh.gov/nhdhr/review or contact the R&C Specialist at christina.st.louis@dcr.nh.gov or 603.271.3558.

PROJECTS CANNOT BE PROCESSED WITHOUT THIS INFORMATION

Project Boundaries and Description

- ☒ Attach the relevant portion of a 7.5' USGS Map (photocopied or computer-generated) ***indicating the defined project boundary.*** *(See RPR Instructions and R&C FAQs for guidance.)*
- ☒ Attach a detailed narrative description of the proposed project.
- ☒ Attach a site plan. The site plan should include the project boundaries and areas of proposed excavation.
- ☒ Attach photos of the project area (overview of project location and area adjacent to project location, and specific areas of proposed impacts and disturbances.) *(Informative photo captions are requested.)*
- ☒ A DHR file review must be conducted to identify properties within or adjacent to the project area. Provide file review results in **Table 1** or within project narrative description. *(Blank table forms are available on the DHR website.)* File review conducted on **7/23/2013**.

Architecture

Are there any buildings, structures (bridges, walls, culverts, etc.) objects, districts or landscapes within the project area? ☒ Yes ☐ No
If no, skip to Archaeology section. If yes, submit all of the following information:

Approximate age(s): **c. 1848**

- ☒ Photographs of ***each*** resource or streetscape located within the project area, with captions, along with a photo key. (Digital photographs are accepted. All photographs must be clear, crisp and focused.)
- ☐ If the project involves rehabilitation, demolition, additions, or alterations to existing buildings or structures, provide additional photographs showing detailed project work locations. (i.e. Detail photo of windows if window replacement is proposed.)

Archaeology

Does the proposed undertaking involve ground-disturbing activity? ☒ Yes ☐ No
If yes, submit all of the following information:

- ☒ Description of current and previous land use and disturbances.
- ☒ Available information concerning known or suspected archaeological resources within the project area (such as cellar holes, wells, foundations, dams, etc.)

Please note that for many projects an architectural and/or archaeological survey or other additional information may be needed to complete the Section 106 process.

DHR Comment/Finding Recommendation *This Space for Division of Historical Resources Use Only*

☐ Insufficient information to initiate review. ☐ Additional information is needed in order to complete review.

☑ No Potential to cause Effects ☐ No Historic Properties Affected ☐ No Adverse Effect ☐ Adverse Effect

Comments: _____

If plans change or resources are discovered in the course of this project, you must contact the Division of Historical Resources as required by federal law and regulation.

Authorized Signature: _____ Date: 11-12-13

Appendix H

Letter to Littleton Off Road Riders

nationalgrid

January 16, 2014

Littleton Off Road Riders
P.O. Box 281
Littleton, NH 03561

Re: New England Power Company d/b/a National Grid
Construction of New Transmission Tap Line

Dear Neighbor:

I am writing to advise you of the proposal of New England Power Company d/b/a National Grid's ("NEP" or the "Company") to construct a new, short tap line off of the Company's existing C203 transmission line (the "Project") to Public Service of New Hampshire's ("PSNH") Littleton Substation located at 266 Foster Hill Road, Littleton, NH just south of Interstate 93/Styles Bridge Highway(Tax Map 41-8).The new tap line will have a rating of 230 kV and will provide power to a second transformer that PSNH will install in its Littleton Substation, which is needed in order to maintain reliable service for the New Hampshire and Vermont areas.

As you may know, representatives of NEP attended the public hearings held on June 25 and July 23, 2013, by the Town of Littleton Zoning Board of Appeals regarding PSNH's application for Special Exceptions to permit related work at its Littleton Substation. Specifically, Project Manager Patrick Quigley, Lead Environmental Scientist Joshua Holden, and myself, were present at one or both hearings to explain the Project scope and to answer questions from the Board and Town residents. We believe at this point that all their questions have been addressed but if that is not the case, please let us know and we would be happy to provide any other information the Town requires.

The new tap line will be approximately 0.2 miles in length and located to the west of an existing right-of-way ("ROW") that is currently occupied by four other existing lines. The Project site is approximately 3.5 acres and primarily zoned Rural with the northernmost portion of the site zoned Commercial III. In order to establish safe clearances from trees and other utility structures NEP will have to expand the ROW by approximately 135 feet.

The new line will be comprised of the new phase conductors supported by four new wooden structures, including one 35-foot tall three-pole structure, two 70 and 80-foot tall H-frame structures, and one guyed 80-foot tall H-frame structure. For comparison purposes, the structures that are currently located in the ROW range in height from 40 to 75 feet. The Company anticipates construction to begin in September 2014 and to be completed in December 2014.

40 Sylvan Road, Waltham, MA 02451
T: 781-907-2206 ■ John.Uphamii@nationalgrid.com ■ www.nationalgrid.com

January 16, 2014

Because the Project will be a new transmission line with a capacity rating that exceeds 200kV, it will be reviewed by the NH Site Evaluation Committee ("NHSEC") pursuant to NH RSA 162-H.In preparing for that NHSEC application, the Company and its consultants have undertaken an extensive analysis and concluded that the Project will have only very minor impacts.

NEP has also reviewed the Town's Master Plan as well as the North Country Council's reports and policies and concluded that the Project is appropriately sited and will not have any adverse impacts on the orderly development in the region or on local land uses and economy. In fact, because the Project is specifically designed to improve electric reliability in the area, it has the potential to have some positive economic impacts. Nor will the Project have any adverse impact on Littleton's infrastructure since it will not increase the demand for municipal sewer, water, fire or police services. Transportation related to construction and operation of the tap line will be consistent with the designation of local roadways and truck traffic will be routed to prevent impacts in the downtown area.

The Town will be provided notice of NEP's NHSEC application and will have further opportunities to comment on NEP's Project. However, NEP would appreciate any comments regarding the Project that the Town can provide in advance of its filing with the NHSEC, which it expects to make by the end of the year.

Please do not hesitate to contact me at 781-907-2206 if you have any questions concerning this Project. The Company looks forward to making these system upgrades to ensure that reliable electric service continues to be provided to the Town of Littleton and surrounding areas.

Sincerely,

John G. Upham, II

cc: Patrick Quigley, National Grid, Project Manager

Appendix I

Notification to Town of Littleton & North Country Council & ZBA Minutes

■

Mark R. Rielly
Senior Counsel

nationalgrid

October 30, 2013

By First Class Mail & Email

Town of Littleton Board of Selectmen
c/o Ceil Stubbings, Executive Secretary
125 Main Street, Suite 200
Littleton, NH 03561
selectmen@townoflittleton.org

Planning Department & ZBA
c/o Joanna Ray
125 Main Street, Suite 200
Littleton, NH 03561
jray@townoflittleton.org

Fred Moody, Town Manager
125 Main Street, Suite 200
Littleton, NH 03561
fmoody@townoflittleton.org

Chief Joseph Mercieri, Jr.
Littleton Fire Department
230 West Main Street
Littleton, NH 03561

Re: New England Power Company d/b/a National Grid
Construction of New Transmission Tap Line

Dear Town of Littleton Officials:

I am writing to advise you of the proposal of New England Power Company d/b/a National Grid's ("NEP" or the "Company") to construct a new, short tap line off of the Company's existing C203 transmission line (the "Project") to Public Service of New Hampshire's ("PSNH") Littleton Substation located at 266 Foster Hill Road, Littleton, NH just south of Interstate 93/Styles Bridge Highway (Tax Map 41-8). The new tap line will have a rating of 230 kV and will provide power to a second transformer that PSNH will install in its Littleton Substation, which is needed in order to maintain reliable service for the New Hampshire and Vermont areas.

As you may know, representatives of NEP attended the public hearings held on June 25 and July 23, 2013, by the Town of Littleton Zoning Board of Appeals regarding PSNH's application for Special Exceptions to permit related work at its Littleton Substation. Specifically, Project Manager Patrick Quigley, Lead Environmental Scientist Joshua Holden, and Director of Stakeholder Relations John Upham, were present at one or both hearings to explain the Project scope and to answer questions from the Board and Town residents. We believe at this point that all their questions have been addressed but if that is not the case, please let us know and we would be happy to provide any other information the Town requires.

The new tap line will be approximately 0.2 miles in length and located to the west of an existing right-of-way ("ROW") that is currently occupied by four other existing lines. The Project site is approximately 3.5 acres and primarily zoned Rural with the northernmost portion

40 Sylvan Road, Waltham, MA 02451
T: 781-907-2111 ■ F: 781-907-5701 ■ Mark.Rielly@nationalgrid.com ■ www.nationalgrid.com

of the site zoned Commercial III. In order to establish safe clearances from trees and other utility structures NEP will have to expand the ROW by approximately 135 feet. Enclosed is a USGS map showing the location of the Project.

The new line will be comprised of the new phase conductors supported by four new wooden structures, including one 35-foot tall three-pole structure, two 70 and 80-foot tall H-frame structures, and one guyed 80-foot tall H-frame structure. For comparison purposes, the structures that are currently located in the ROW range in height from 40 to 75 feet. The Company anticipates construction to begin in September 2014 and to be completed in December 2014.

Because the Project will be a new transmission line with a capacity rating that exceeds 200kV, it will be reviewed by the NH Site Evaluation Committee ("NHSEC") pursuant to NH RSA 162-H. In preparing for that NHSEC application, the Company and its consultants have undertaken an extensive analysis and concluded that the Project will have only very minor impacts.

NEP has also reviewed the Town's Master Plan as well as the North Country Council's reports and policies and concluded that the Project is appropriately sited and will not have any adverse impacts on the orderly development in the region or on local land uses and economy. In fact, because the Project is specifically designed to improve electric reliability in the area, it has the potential to have some positive economic impacts. Nor will the Project have any adverse impact on Littleton's infrastructure since it will not increase the demand for municipal sewer, water, fire or police services. Transportation related to construction and operation of the tap line will be consistent with the designation of local roadways and truck traffic will be routed to prevent impacts in the downtown area.

The Town will be provided notice of NEP's NHSEC application and will have further opportunities to comment on NEP's Project. However, NEP would appreciate any comments regarding the Project that the Town can provide in advance of its filing with the NHSEC, which it expects to make by the end of the year.

Please do not hesitate to contact me if you have any questions concerning this Project. The Company looks forward to making these system upgrades to ensure that reliable electric service continues to be provided to the Town of Littleton and surrounding areas.

Sincerely,

Mark R. Rielly

Encl.
cc: Patrick Quigley, National Grid, Project Manager
Barry Needleman, Esq., McLane, Graf, Raulerson, & Middleton, PA, Counsel for NEP

Mark R. Rielly
Senior Counsel

nationalgrid

December 27, 2013

By Email (tbamford@nccouncil.org)

Tara Bamford, Regional Planner
North Country Council
107 Glessner Road
Bethlehem, NH 03574

Re: New England Power Company d/b/a National Grid
Construction of New 230 kV Transmission Tap Line

Dear Ms. Bamford:

As we discussed on our call on December 20, 2013, New England Power Company d/b/a National Grid's ("NEP" or the "Company") is proposing to construct a new, short tap line off of the Company's existing C203 transmission line (the "Project") connecting to Public Service of New Hampshire's ("PSNH") Littleton Substation located at 266 Foster Hill Road, Littleton, NH just south of Interstate 93/Styles Bridge Highway (Tax Map 41-8). The Project requires approval by the New Hampshire Site Evaluation Committee ("SEC") because the tap line will have a design rating of 230 kV, slightly above the SEC's 200-kV jurisdictional threshold. Accordingly, the Company must show, among other things, that the site and facility will not unduly interfere with orderly development of the region with due consideration given to the views of municipal and regional planning commissions and municipal governing boards. Given the limited size and scope of the Project, the Company strongly believes that the Project will not unduly interfere with orderly development of the region and seeks the concurrence of the North Country Council ("NCC").

Project Description

The proposed new 230 kV tap line will provide power to a new, second transformer that PSNH will install in its Littleton Substation. ISO-NE has determined that the second transformer, and by extension the tap line, are needed in order to maintain reliable service for the Northern New Hampshire and Vermont region.

The new tap line would be approximately 0.2 miles in length and would be located within a newly widened area to the west of an existing right-of-way ("ROW") that is currently occupied by four other existing lines. Enclosed is a USGS map showing the location of the Project. The Project site is approximately 3.5 acres and primarily zoned Rural with the northernmost portion of the site zoned Commercial III. In order to establish safe clearances from trees and other utility structures NEP will have to widen the existing ROW by approximately 135 feet to the west.

40 Sylvan Road, Waltham, MA 02451
T: 781-907-2111 ■ F: 781-907-5701 ■ Mark.Rielly@nationalgrid.com ■ www.nationalgrid.com

The new line will be comprised of new phase conductors supported by four new wooden structures, including one 35-foot tall three-pole structure, two 70 and 80-foot tall H-frame structures, and one guyed 80-foot tall H-frame structure. For comparison purposes, the structures that are currently located in the ROW range in height from 40 to 75 feet. NEP will coordinate the location of the proposed new supporting structures with the existing structures in the ROW to achieve a uniform, blended appearance. The Company anticipates construction to begin in September 2014 and to be completed in December 2014.

Environmental Analysis and Municipal Outreach

In preparing for the SEC application, the Company and its consultants undertook extensive environmental analyses and concluded that the Project will have only very minor impacts. For instance, the Project will create only 49.5 square feet of permanent wetland impacts and will not have an adverse effect upon any viewsheds, air or water quality, archeological or historic resources, or protected species habitat. The Company would be happy to provide these analyses upon request.

The Company has also solicited the input of municipal officials. Representatives of NEP attended the public hearings held on June 25 and July 23, 2013, by the Town of Littleton Zoning Board of Appeals regarding PSNH's application for Special Exceptions to permit work at its Littleton Substation related to installing a second transformer. Specifically, Project Manager Patrick Quigley, Lead Environmental Scientist Joshua Holden, and Director of Stakeholder Relations John Upham, were present at one or both hearings to explain the Project scope and to answer questions from the Board and Town residents. Importantly, the Zoning Board found "that the site was an appropriate location for such a use;" "that property values would not be reduced;" and "that the request would not be a nuisance or cause an unreasonable hazard." ZBA Minutes, June 25, 2013 (enclosed herewith).

The Project also will not have any adverse impact on Littleton's infrastructure since it will not increase the demand for municipal sewer, water, fire or police services. Transportation related to construction and operation of the tap line will be consistent with the designation of local roadways and truck traffic and will be routed to prevent impacts in the downtown area.

NEP has also reviewed the Town's Master Plan goals and policies and has concluded that the Project is appropriately sited and will not have any adverse impacts on the orderly development in the region or on local land uses and economy. Indeed, by resolving the operational need identified by ISO- NE in Northern New Hampshire, the Project will improve the reliability of electric service in the area, which will have a beneficial impact on the development of the region.

By letter dated October 30, 2013, the Company solicited further comments from the Town Board of Selectmen, the Town Manager, the Zoning and Planning Boards, and the Chief of the Fire Department. To date, none of these officials have offered any further comments or expressed any concerns regarding the Project. The Town will be provided notice of NEP's SEC application and will have further opportunities to provide comments to the SEC regarding the

North Country Council
December 27, 2013

Project. Moreover, as is its regular practice, the Company's Stakeholder Relations representative will continue to work closely with the Town and abutters of the Project site to keep them informed about construction activities and schedules and to address any concerns raised during and after Project construction.

The Company looks forward to making these system upgrades to ensure that reliable electric service continues to be provided to the Town of Littleton and surrounding areas. Thus, the Company would appreciate NCC's input regarding whether it concurs with the Company's conclusion that the Project will not unduly interfere with orderly development of the region. To this end, please do not hesitate to contact me if you need any additional information or have any questions.

Sincerely,

Mark R. Rielly

Encl.
cc: Patrick Quigley, National Grid, Project Manager
Barry Needleman, Esq., McLane, Graf, Raulerson, & Middleton, PA, Counsel for NEP

Littleton, New Hampshire

About Littleton
Municipal Departments
Committees
Reports, Forms, & Fees
Frequently Asked Questions
Municipal news
Tax Maps Online
Town Maps online
Master Plan
Employment
Contact
Home

Select Board Minutes/Agendas
Zoning/Planning Board Notices
Town Manager's Corner

Town of Littleton

Town Office Hours:
Monday-Thursday
8:30 am - 4 pm
Closed 12:30 - 1:00
Friday: 8:30 - 12:30

125 Main Street, Suite 200
Littleton, NH 03561
Phone: 603.444.3996
Fax: 603.444.1703

Town Clerk's Hours and Direct Fax line

Planning & Zoning

View Meeting Minutes for: | 2013 | 2012 | 2011 | 2010 | 2009 |

Approved Zoning Board Minutes Jun 25, 2013

LITTLETON ZONING BOARD OF ADJUSTMENT
DRAFT MINUTES
TUESDAY, JUNE 25, 2013
COMMUNITY HOUSE HEALD ROOM
LITTLETON, NH 03561
6:00 PM

Present: Chairman Harold Bigelow, Vice Chair Eddy Moore, Cary Clark, Tom Loughlin and Joanna Ray (recording secretary)

Excused: Sean Sweeney, Guy Harriman, and Heidi Hurley

Others: Darin Wipperman (The Courier), Pat Kellogg, Marghie Seymour, Laura Games, Alan Roe, Sandra Gagnon, John Upham, Josh Holden, Patrick Quigley

2013 Meeting Minutes and Agendas

- Draft Planning Board Minutes Dec 3, 2013
- Approved Planning Board Minutes Nov 19, 2013
- Approved Planning Board Minutes Nov 5, 2013
- Approved Zoning Board Minutes Oct 22, 2013
- Approved Planning Board Minutes Oct 15, 2013
- Approved Zoning Board Minutes Oct 8, 2013
- Approved Planning Board Minutes Oct 1, 2013
- Approved Planning Board Minutes Sep 17, 2013
- Approved Planning Board Minutes Aug 6, 2013
- Approved Zoning Board Minutes Jul 23, 2013
- Approved Planning Board Minutes Jul 16, 2013
- Approved Zoning Board Minutes Jul 9, 2013
- Approved Zoning Board Minutes Jun 25, 2013
- Approved Zoning Board Minutes Jun 11, 2013
- Approved Planning Board Minutes Jun 4, 2013
- Approved Planning Board Minutes May 21, 2013
- Approved Zoning Board Minutes May 14, 2013
- Approved Planninig Board Minutes May 7, 2013
- Approved Zoning Board Minutes Apr 23, 2013
- Approved Planning Board Minutes Apr 16, 2013
- Approved Minutes Apr 2, 2013
- Approved Planning Board Minutes Mar 5, 2013
- Approved Planning Board Minutes Feb 19, 2013
- Approved Planning Board Minutes Jan 15, 2013

Chairman Bigelow called the meeting to order at 6:00 PM. Chairman Bigelow informed the applicant that four board members were present and the applicant is entitled to a five member board. Laura Games said she was willing to go ahead and present to the four member board. Tom Loughlin was appointed as a voting member for this meeting.

Vice Chair Moore made a motion to accept the case as complete. Cary Clark seconded the motion. The motion passed.

Review of June 11, 2013 minutes

Vice Chair Moore made a motion to approve the minutes as written Tom Loughlin seconded the motion. The motion passed. Chairman Bigelow read the role of the board as well as procedure. Appendix I

PSNH – ZBA13-07 – Request for a Special Exception relating to Article VI, Section 6.01 of the Littleton Zoning Ordinance to allow a fence over 6' tall at 266 Foster Hill Rd, tax map 41-8, in the Rural zone.

Laura Games introduced herself as the licensing and permitting specialist for PSNH, Alan Roe is the project manager, Sandra Gagnon is project outreach for PSNH, John Upham is from stakeholder relations with National Grid, Josh Holden is environmental permitting with National Grid, and Patrick Quigley is project manager with National Grid.

Laura Games started the presentation by stating their proposal has nothing to do with Northern Pass. The current fence at the site is 6' tall with another 1' of barbed wire. The proposal is to replace the existing fence with one that is 7' tall with an additional 1' of barbed wire. The footprint will be the same. The change is due to current company standards.

Laura Games read the responses from the application.

Tom Loughlin asked if the site was illuminated. Alan Roe said the lights come on automatically. Alan said the swing gate will be replaced with a roller gate. There are less problems with them during the winter.

There was no one present that wished to speak in favor of or against the request. The public input portion was closed. The Board agreed that the site was an appropriate location for such a use. The Board agreed that property values would not be reduced because there is already a fence. The Board agreed that the request would not be a nuisance or cause an unreasonable hazard. The Board agreed that there would be adequate and appropriate facilities provided for the proper operation and maintenance because the fence is similar to the existing one. Tom Loughlin asked how often the area was patrolled. Alan Roe expects the area will inspected monthly. There are security cameras at the site. Tom suggested asking local law enforcement to patrol the site. The Board considered this suggestion to be a possible condition of approval. Alan said there is a gate that the police could not get through to patrol the site. A patrol could only be done from the road.

Cary Clark made a motion to approve PSNH – ZBA13-07 – Request for a Special Exception relating to Article VI, Section 6.01 of the Littleton Zoning Ordinance to allow a fence over 6' tall at 266 Foster Hill Rd, tax map 41-8, in the Rural zone with the following conditions:

• The fence not to exceed 8' including the barbed wire

• The applicant must comply with all Federal, State, and Local regulations

Vice Chair Moore seconded the motion. The motion passed.

PSNH – ZBA13-08 – Request for a Special Exception relating to Article XI, Section 11.02 of the Littleton Zoning Ordinance to allow an expansion of a non-conforming use at 266 Foster Hill Rd, tax map 41-8, in the Rural zone.

Laura Games explained that the project is within the existing yard. The proposed work was deemed necessary by ISO-NE in their regional plan in order to maintain the safety and liability of the station infrastructure. To mitigate thermal overloads and voltage violations in northern New Hampshire and northern Vermont, a second 230/115kV autotransformer will be added and a 230kV C203 Comerford-Moore line tap into the Littleton substation. The line tap will require a 115kV bay and 2 new circuit breakers at the Littleton substation. Alan Roe added that the line tap is needed in order for the project to work. Everything within the fence is PSNH equipment. From the fence line to the existing C203 line is National Grid. The project is not a back-up system. Patrick Quigley said that this work will help create a balance.

Marghie Seymour asked if it made sense to use one or the other instead of both. Alan Roe responded no. Alan also said that the new line tap is approximately .2 miles long and is required to commission the second transformer. Foundations will be created. Minor modifications will be done to the existing transformer. A wave trap will be removed because it is no longer required. Tom Loughlin asked if the transformers working parallel will reduce the load on them. Alan responded yes. Marghie asked if it was an alternating current. Alan responded yes. It could not handle a direct current. Alan continued through his power-point presentation. A copy of the presentation is will be in the case file.

Tom Loughlin asked what the new tower height will be. Alan Roe replied that it will be roughly 95' from the ground to the top of the lightning rod. The A-frame structure is 75'. The new structure is roughly the same height at the current structure.

There was discussion regarding a possible increase in noise level. Alan Roe said he is not expecting the level to increase. A baseline noise survey is scheduled for some time in the next few weeks. If there is an increase, it will be addressed. Chairman Bigelow said this is an important piece of information at this time. Alan stated there were be no cell phone interference.

Pat Kellogg asked if PSNH could put a DC converter at this substation. The DC line comes into Monroe and goes to MA. The converter station in Monroe has been demolished, but the lines are still there.

Cary Clark asked if the noise will be louder with both transformers working. John Upham said it depends on the load of the transformer. One will increase when the other decreases.

Vice Chair Moore suggested a condition that the noise level could not increase. Cary Clark said the Board is thinking about future property owners and builders in that area. Alan Roe said that having no change in noise would be unrealistic. There might be an increase, but only within a small area.

Pat Kellogg suggested a photo of what the current height is and what the proposed will be. Marghie Seymour suggested the applicant find out what the current noise level is and what the proposed will be.

Vice Chair Moore made a motion to continue the hearing until July 9, 2012 at 6 PM in the Community House Heald Room to allow the applicant time to supply the following:
• Visuals regarding the current and proposed heights of the tower heights
• Projected noise increase in comparison to the current noise level

The applicant may supply a letter to the Planning & Zoning Office if they feel they will need an extension of the July 9, 2013 hearing. Cary Clark seconded the motion. The motion passed.

There was no other business on the agenda. At 7:05, Vice Chair Moore made a motion to adjourn. Tom Loughlin seconded the motion. The motion passed.

Submitted by,
Joanna Ray

Planning Board

The Planning Board meets regularly on the first and third Tuesdays of each month at 6 pm.

Please contact the Planning Department at (603) 444-3996 X27 or e-mail Joanna Ray at jray@townoflittleton.org for further information or to schedule a hearing.

Zoning Board of Adjustment

The Zoning Board of Adjustment meets on the second and fourth Tuesday of each month at 6 pm pending any hearings are necessary.

Please contact the Planning Department at (603) 444-3996 X27 or e-mail Joanna Ray at jray@townoflittleton.org for further information or to schedule a hearing.

Applications and Forms

For free downloadable copies of application forms and the ordinances, visit the Applications and Forms page.

The Town of Littleton prohibits discrimination on the basis of race, color, national origin, sex, sexual orientation, religion, age, disability, marital or family status. The Town of Littleton is an equal opportunity employer.

Littleton, New Hampshire

About Littleton
Municipal Departments
Committees
Reports, Forms, & Fees
Frequently Asked Questions
Municipal news
Tax Maps Online
Town Maps online
Master Plan
Employment
Contact
Home

Select Board Minutes/Agendas
Zoning/Planning Board Notices
Town Manager's Corner

Town of Littleton

Town Office Hours:
Monday-Thursday
8:30 am - 4 pm
Closed 12:30 - 1:00
Friday: 8:30 - 12:30

125 Main Street, Suite 200
Littleton, NH 03561
Phone: 603.444.3996
Fax: 603.444.1703

Town Clerk's Hours and Direct Fax line

Planning & Zoning

View Meeting Minutes for: | 2013 | 2012 | 2011 | 2010 | 2009 |

Approved Zoning Board Minutes Jul 23, 2013

LITTLETON ZONING BOARD OF ADJUSTMENT
DRAFT MINUTES
TUESDAY, JULY 23, 2013
COMMUNITY HOUSE HEALD ROOM
LITTLETON, NH 03561
6:00 PM

Present: Chairman Harold Bigelow, Vice Chair Eddy Moore, Heidi Hurley, Cary Clark, Sean Sweeney, Tom Loughlin, and Joanna Ray (recording secretary)

Excused: Guy Harriman

Others: Laura Games, Patrick Quigley, Alan Roe, Doug Bell, Pat Kellogg, Dolly McPhaul, Chris Hodge, Darin Wipperman

2013 Meeting Minutes and Agendas

- Draft Planning Board Minutes Dec 3, 2013
- Approved Planning Board Minutes Nov 19, 2013
- Approved Planning Board Minutes Nov 5, 2013
- Approved Zoning Board Minutes Oct 22, 2013
- Approved Planning Board Minutes Oct 15, 2013
- Approved Zoning Board Minutes Oct 8, 2013
- Approved Planning Board Minutes Oct 1, 2013
- Approved Planning Board Minutes Sep 17, 2013
- Approved Planning Board Minutes Aug 6, 2013
- Approved Zoning Board Minutes Jul 23, 2013
- Approved Planning Board Minutes Jul 16, 2013
- Approved Zoning Board Minutes Jul 9, 2013
- Approved Zoning Board Minutes Jun 25, 2013
- Approved Zoning Board Minutes Jun 11, 2013
- Approved Planning Board Minutes Jun 4, 2013
- Approved Planning Board Minutes May 21, 2013
- Approved Zoning Board Minutes May 14, 2013
- Approved Planninig Board Minutes May 7, 2013
- Approved Zoning Board Minutes Apr 23, 2013
- Approved Planning Board Minutes Apr 16, 2013
- Approved Minutes Apr 2, 2013
- Approved Planning Board Minutes Mar 5, 2013
- Approved Planning Board Minutes Feb 19, 2013
- Approved Planning Board Minutes Jan 15, 2013

Chairman Bigelow called the meeting to order at 6:00 PM. Roll call. Guy Harriman was excused.

Review of July 9, 2013 minutes.

Sean Sweeney made a motion to approve the minutes as written. Cary Clark seconded the motion. Chairman Bigelow did not vote. The motion passed.

Continuation of: PSNH – ZBA13-08 – Request for a Special Exception relating to Article XI, Section 11.02 of the Littleton Zoning Ordinance to allow an expansion of a non-conforming use at 266

Foster Hill Rd, tax map 41-8, in the Rural zone

Chairman Bigelow reminded everyone that this case was continued so that the applicant could present additional data.

Laura Games recapped by stating the proposed work is within the existing substation yard. This work is necessary for mitigating overloads. None of the proposed work is associated with Northern Pass. Questions regarding any increase of noise and the height of the new equipment will be addressed at this meeting. With Laura was Alan Roe (project manager with PSNH), Patrick Quigley (project manager with National Grid), and Doug Bell (principal consultant with Cavanaugh Tocci Associates).

Alan Roe presented photos of the existing structure heights as well as the proposed. The existing structures are 66 ft. and 68 ft. tall. This includes the lightning masts. The proposed structure is 75 ft. high with 20 ft. of lightning mast.

Tom Loughlin asked if there was a DC converter. Alan Roe responded no. Tom also asked if PSNH will restart the discontinued DC line in Monroe. Alan replied that line belongs to National Grid. The converter has been removed, but the line is still there.

Patrick Quigley stated the area outside of the fence is National Grid. Patrick explained that he was attending the meeting in order to assist PSNH with the permitting of the project, with the board's understanding that National Grid's project is jurisdictional under the Site Evaluation Committee. He wanted to ensure that the Zoning Board of Adjustment as well as its constituents had a clear understanding of the scope of National Grid's project, and answer any questions that the board or its constituents would have National Grid is still in the structural analysis phase. Their poles are about 70 ft. tall with 9 ft. in the ground.

Tom Loughlin asked if one of the transformers is a backup. Alan Roe said it would run in tandem with the original transformer. If the old one fails, the new one will pick up more. Chris Hodge, Littleton Zoning Officer, asked if the power services Coos County. Laura Games replied that Coos County is listed in the ISO regional plan. A copy of this is at the Town Office. Patrick Quigley stated that this proposal will create a more balanced system.

Alan Roe and Dolly McPhaul discussed if these lines would be used with Northern Pass and if they would go towards Sugar Hill. Alan said he did not know if they go along the right-of-way towards Sugar Hill. Laura Games added that page one of the regional plan for this project discusses their liability purposes. Dolly stated that she was still not convinced that this project is legit. Alan said that this project is legit and has nothing to do with Northern Pass.

Cary Clark asked why the equipment needs to be higher than the

existing. Alan Roe responded that it was a combination of the existing footprint and needing access. He was not sure if it is feasible to build them shorter. The lightning mast at 95 ft. is needed.

Vice Chair Moore if there would be any change in the line that comes from Comerford Dam to Littleton. Alan Roe replied no. Patrick Quigley replied that there would be no change on the distribution side. Chris Hodge asked if there was any other location available. Alan said that the transformer has been on site since 2010. They already received zoning approval to have it there. Tom Loughlin asked about peak demand time. Alan stated that typically it is during the summer when air conditioners are being used.

Chairman Bigelow stated that these connections are ancillary to what is there.

Doug Bell, principal consultant with Cavanaugh Tocci Associates, was hired to assess the environmental impact of the noise created by the new transformer. Measures were documents onsite and nearby the site at 6PM on a Tuesday and 2AM the following Wednesday. The new transformer came with a low noise of 61 decibels and the existing is at 80. Measuring them together is a different formula. The new transformer is 100 times quieter than the original. There will be no incremental noise. No one will know it is on. Current regulations mandate new transformers to be quiet. The existing transformer produces between 30-33 decibels at the nearest residence. Cary Clark stated that the Board has to consider not only the current residents but future ones as well. Doug stated that he measured about 42 decibels at the fence line. Vice Chair Moore asked if the old transformer was replaced with a new one, there would be almost no sound. Doug said that was correct.

Sean Sweeney asked if there were any lights on the masts. Alan Roe replied that there would be lights on the proposed structure. There are currently lights on the wood poles that are used when doing emergency repairs after dark. They are not on unless needed. They are manually operated. Sean also asked if the existing equipment will remain. Alan stated that very little is coming out of service.

Dolly McPhaul stated she had previously spoken to Alan Roe and Patrick Quigley about there being five new wooden towers in the substation. Alan stated there would not be any. Patrick stated there might be some in the National Grid area, but not any higher than the current ones and would be in the existing right-of-way. Dolly also asked about needing 2.2 miles of new right-of-way. Alan showed a picture of the current lines and the new tap line that is in the same right-of-way.

Vice Chair Moore asked if this project would create additional revenue to the Town. Alan Roe replied that it is about $9million in assets. Dolly McPhaul asked if it would decrease over the years. Alan

responded that he did not know how it would be assessed.

Chairman Bigelow closed the public portion of the hearing. The Board discussed possible conditions of approval. There was concerns over the line being used for Northern Pass in the future. The question of noise had been addressed as well as the reason for the height of the new structure. There will be no work done outside of the current substation. Chairman Bigelow voiced concern over not adding conditions that are outside the Board's authority or outside of what the current request is for.

The Board reviewed the findings of the facts. The Board agreed that the site was an appropriate location for this use.

In response to the second question about property values in the district not being reduced, Sean Sweeney asked what district is considered. Chairman Bigelow stated the rural zone. There was continued discussion about there being a sentiment of distrust and not wanting to facilitate Northern Pass. Chairman Bigelow stated that the applicant already said this project does not involve Northern Pass. Heidi Hurley stated her concerns about what might happen in the future. Tom Loughlin suggested a condition of stating there be no transfer switch to allow Northern Pass. Heidi said the abutters should be protected. Chairman Bigelow did not know if such a condition would stand up in court. Heidi stated she did not want to see PSNH sell out to Northern Pass in the future. Sean stated that secondary impacts should be considered. Is this going to enable other projects that will have adverse effects? Vice Chair Moore said that the Board is dealing with what is within the fence and that other lines are out of the Board's jurisdiction. Tom said he did not disagree with PSNH hooking up the new transformer

Vice Chair Moore stated that there would be no additional noise from the new transformer.

Chairman Bigelow did not feel that the Board has any jurisdiction to add a condition regarding protection from Northern Pass. Vice Chair Moore reminded the Board of the conditions placed on PSNH's approval from 2010. The map was made part of the decision and any major changes were to be brought back to the Board for approval.

Alan Roe stated that the plans presented with the application were not the final design plans. He is not expecting anything to change, but there might be a minor change of moving a structure by 6". There was continued discussion about the final plan. Chris Hodge stated that any major changes would have to be presented to the Board for approval, but any minor ones could be approved by him. These minor changes are usually based on construction issues that come up. Chairman Bigelow said the Board should leave that part to Chris' discretion. Chris said that no building permit would be issued until there is a final plan.

Cary Clark made a motion to approve PSNH – ZBA13-08 – Request for a Special Exception relating to Article XI, Section 11.02 of the Littleton Zoning Ordinance to allow an expansion of a non-conforming use at 266 Foster Hill Rd, tax map 41-8, in the Rural zone with the following conditions:

• The site layout map is to be part of the decision
• Any changes to the map must be submitted to the Zoning Officer for review and any changes deemed major will require ZBA approval
• Additional use and equipment approved here is only for the applicants stated purpose of improving system reliability as mandated by ISO New England
• Applicant must comply with all Federal, State, and Local regulations

Vice Chair Moore seconded the motion. The motion passed 5-0. The applicant was informed about the 30-day appeal period.

At 7:45, Cary Clark made a motion to adjourn. Sean Sweeney seconded the motion. The motion passed by all.

Submitted by,
Joanna Ray

Planning Board

The Planning Board meets regularly on the first and third Tuesdays of each month at 6 pm.

Please contact the Planning Department at (603) 444-3996 X27 or e-mail Joanna Ray at jray@townoflittleton.org for further information or to schedule a hearing.

Zoning Board of Adjustment

The Zoning Board of Adjustment meets on the second and fourth Tuesday of each month at 6 pm pending any hearings are necessary.

Please contact the Planning Department at (603) 444-3996 X27 or e-mail Joanna Ray at jray@townoflittleton.org for further information or to schedule a hearing.

Applications and Forms

For free downloadable copies of application forms and the ordinances, visit the Applications and Forms page.

The Town of Littleton prohibits discrimination on the basis of race, color, national origin, sex, sexual orientation, religion, age, disability, marital or family status. The Town of Littleton is an equal opportunity employer.

Appendix J

NHDES Section 401 WQC

State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES
Water Division
29 Hazen Drive, PO Box 95,
Concord, New Hampshire 03302-0095
Attn: 401 Water Quality Certification Program
Phone (603) 271-2457 Fax (603) 271-7894

APPLICATION FOR 401 WATER QUALITY CERTIFICATION

Date of Request **January 31, 2014**

Date Request Received by DES _____

I. Applicant Information

Principal Place of Business of the Applicant **New England Power d/b/a National Grid**	
Mailing Address [Street, PO Box, RR, etc.] **40 Sylvan Road**	
City/Town and Zip Code **Waltham, Massachusetts 02451**	
Telephone No. **781-907-3648**	Email Address **Joshua.Holden@nationalgrid.com**
Name and Title of Signatory Official Responsible for the Activity for which Certification is Sought (e.g., President, Administrator) **Joshua B. Holden, Lead Environmental Engineer, Environmental Permitting- New England**	

II. Project Information

Name of Project **Proposed 230kV C203 Tap Line**
Name of Town and County that contains the Project **Town of Littleton, Grafton County**
Name of Receiving Waterbody and Drainage Basin **Unnamed Brook (NHRIV801030203-08), Comerford Dam Reservoir**
Summary of Activity (e.g., construction, operation, or other practice or action) **The proposed C203 Tap Line Project involves construction of a new 0.2-mile tap line extending south from the existing C203 overhead transmission line to the Littleton Substation in Littleton, New Hampshire. Construction of this new tap line will provide an additional power**

REQUEST FOR 401 WATER QUALITY CERTIFICATION (cont.)

appropriate stormwater management measures, which must be effectively designed, installed, and maintained to ensure compliance with surface water quality standards.

- A description of any other aspect of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water.
- An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points.
- A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number.
- A copy of the DES wetlands permit (RSA 482-A:3), if necessary.
- A copy of the DES alteration of terrain permit (RSA 485-A:17), if necessary.
- The name(s) and address(es) of adjoining riparian or littoral abutters.
- A plan showing the proposed activities to scale including:
  - The location(s) and boundaries of the activities;
  - The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and
  - The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands.

Signature - MUST BE SIGNED AND DATED BY APPLICANT

To the best of my knowledge, the data and information described above, which I have submitted to the New Hampshire Department of Environmental Services, is true and correct. I understand that an approval of the requested 401 Certification based upon incorrect data may be subject to revocation of the 401 Certification. I have complied with all local regulations or ordinances relative to the proposed activity and have obtained or will obtain, prior to the commencement of any work, all other approvals that may be required.

Signed: Joshua B Teller

Date: January 31, 2014

Additional Submittal Information
Application for a 401 Water Quality Certification
Proposed C203 Tap Line, Littleton, NH
New England Power d/b/a National Grid

Type of activity (e.g., construction, operation, other action such as water withdrawal) and the start and end dates of the activity.

The proposed C203 Tap Line Project involves construction of a new 0.2-mile long tap line extending south from the existing C203 overhead transmission line to the Littleton Substation in Littleton, New Hampshire. Construction of this new tap line will provide an additional power source to a second autotransformer installed within the Littleton Substation. The new power source will address much warranted reliability needs resultant of increasing demand both in New Hampshire and Vermont. The proposed C203 Tap Line installation will consist of installation of three new wood H-frame structures and one three-pole dead end structure immediately north of the Littleton Substation along with associated conductors.

Project construction is scheduled to begin in September 2014, with construction completed in order to meet the in-service date of December 2014.

The characteristics of the activity: Whether the activity is associated with a discharge and/or water withdrawal and whether the discharge and/or withdrawal is proposed or occurring.

The Project involves impacts to wetlands as described in the Standard Dredge and Fill Application for the project. There are no discharges or water withdrawals proposed for the Project.

The characteristics of the discharge and/or withdrawal:

- **Flow rate (cfs)**
- **Potential chemical, physical, biological constituents**
- **Frequency (e.g., daily, hourly,)**
- **Duration**
- **Temperature (Celsius)**
- **Latitude and longitude (dd:mm:ss)**

Not Applicable.

The existing and designated use(s) that are potentially affected by the proposed activities. (Designated Uses are listed in the DES Consolidated Assessment and Listing Methodology).

No surface waters are located within the construction footprint of the Project. An unnamed perennial stream and an intermittent channel run adjacent to (to the west of) the Project area. The unnamed perennial channel (identified as "Unnamed Brook – Assessment Unit ID NHRIV801030203-08) was included in the Draft 2012 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology. The New Hampshire Watershed Report Card is attached. Currently, the perennial stream is not used for purposes included under the "designated uses" Class B category of surface waters.

The provision(s) of surface water quality standards (Env-Wq 1700) that are applicable to the designated uses affected by the proposed activities.

Not Applicable.

A pollutant loading analysis to show the difference between pre-development and post-development pollutant loads for a typical year. The objective of the loading analysis is to show post-development pollutant loads do not exceed pre-development pollutant loads. Loading analysis guidance and a simple spreadsheet model will be provided by DES. The loading analysis will be used to determine appropriate stormwater management measures, which must be effectively designed, installed, and maintained to ensure compliance with surface water quality standards.

Not Applicable.

A description of any other aspect of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water.

No surface waters are located within the construction footprint of the proposed Project and therefore no direct impacts to the chemical composition, temperature, flow or physical aquatic habitat of any surface water will occur. Appropriate erosion controls will be implemented during construction to eliminate the potential of sediment from entering adjacent wetlands and/or surface waters.

There should be no measurable indirect impacts, such as an increase in water temperature and/or sedimentation, to the unnamed perennial stream and unnamed intermittent stream located to the west of the construction footprint as a result of the proposed Project. This conclusion is based on the fact that a forested buffer of at least 50 feet will be maintained, and the fact that the cleared area drains to the east into the ROW and away from the existing streams.

An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points.

Figure 1- USGS Site Location Map is attached, depicting the general site location.

A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number.

No permit application has been filed with the US Army Corps of Engineers as of the date of this request. We anticipate that the Project will be authorized under the Statewide Programmatic General Permit. As is the standard procedure for General Permits, the NHDES Wetlands Bureau Permit will serve as the technical documentation reviewed by the Army Corps. An Army Corps permit number will be supplied to the Watershed Management Bureau once it is issued by the Corps.

A copy of the DES wetlands permit (RSA 482-A:3), if necessary.

Please see the SEC Application.

A copy of the DES alteration of terrain permit (RSA 485-A:17), if necessary.

Not Applicable. The Project does not propose terrain alteration exceeding 100,000 square feet.

The name(s) and address(es) of adjoining riparian or littoral abutters.

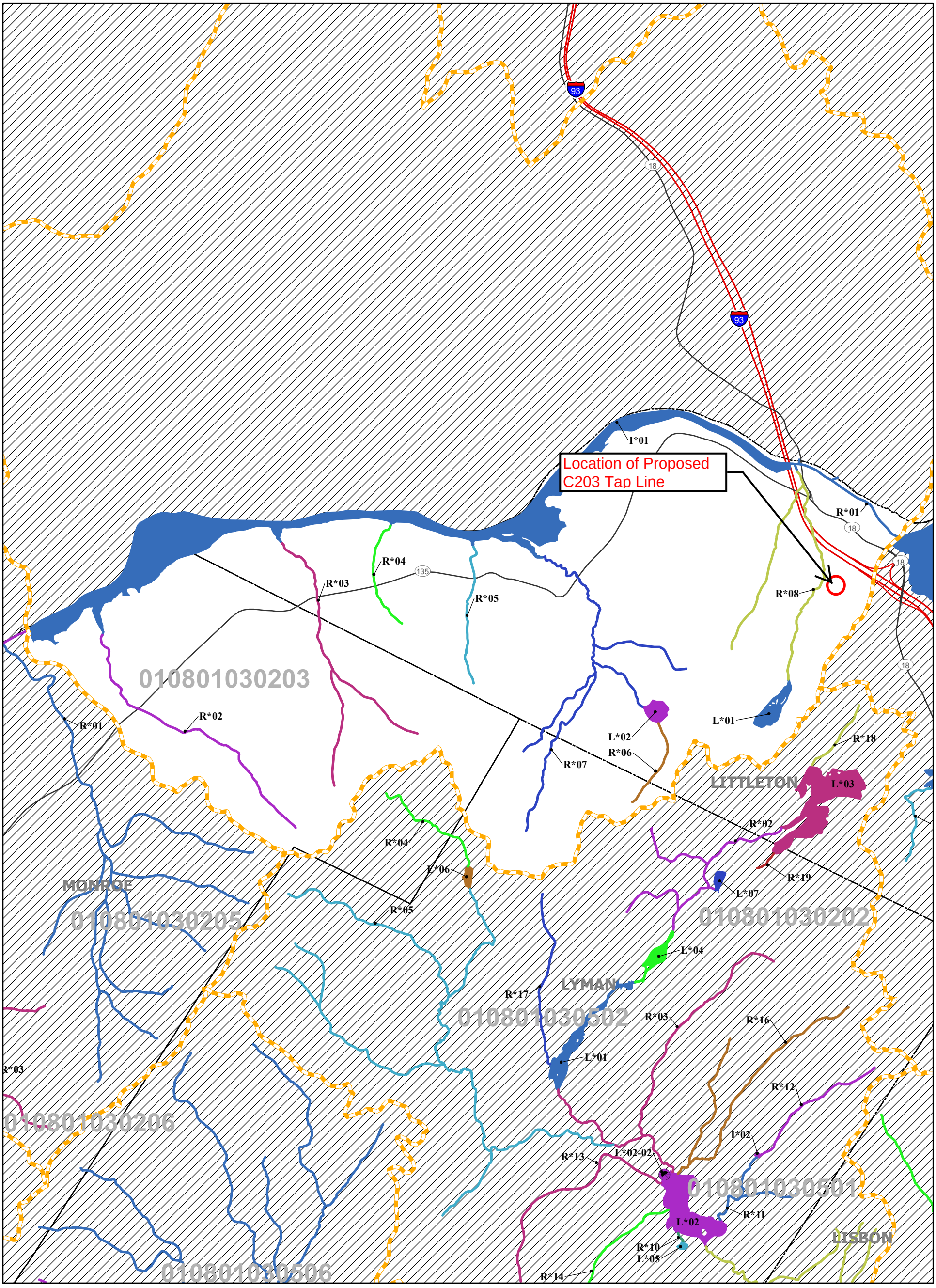
Abutters were identified and notified under the rules of the NH Wetlands Permit Application. The attached table lists the abutters adjacent to the project parcels.

A plan showing the proposed activities to scale including:

- **The location(s) and boundaries of the activities;**
- **The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and**
- **The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands.**

Figure 2 – Project Area Wetlands Map is attached. Additional detailed plans are available within the NHDES Wetlands Bureau Application.

AUIDs For HUC12: 010801030203 - Comerford Dam Reservoir



HUC12 Boundaries
Town Boundaries
Major Roads
Interstate Highway
US Highway
State Highway

Assessment Unit Coloring AUs Ending with:

0 =
1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =

N
W E
S

Abbrv. Label	HUC 12
L* 03	010 700060201

AUID = NH L AK 700060201 - 03

Assessment Unit IDs are derived from the HUC12 they reside within. The labels have been shortened on this map for presentation purposes.
Example: the Label "L*03" in HUC12 = 010700060201 represents AUID = "NHLAK700060201-03"
In rare cases where an AUID extends beyond the boundary of a single HUC12, additional portions of the end of the HUC 12 number have also been replaced.

0 0.4 0.8 1.2 1.6 Miles

Scale:1:42,130

H:\Water Quality\305(B)-303(D) PROGRAM\2012\AUIDs\HUC12Maps

Assessment Unit ID NHRIV801030203-08 Size 2.9890 MILES

Assessment Unit Name UNNAMED BROOK Beach N

Primary Town LITTLETON Assessment Unit Category*~ 3-ND

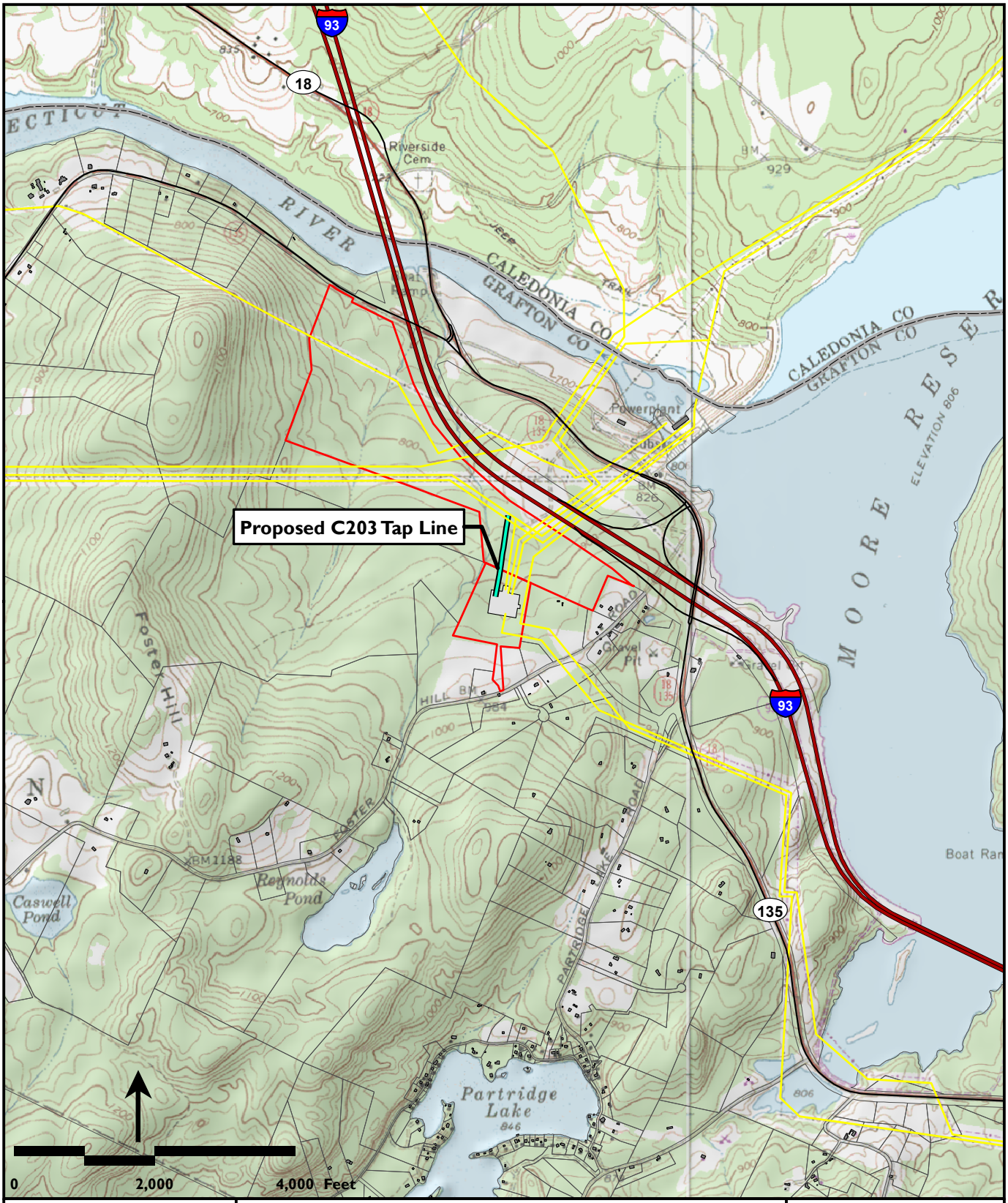
DRAFT 2012, 305(b)/303(d) - All Reviewed Parameters by Assessment Unit

Designated Use Description	*Desig. Use Category	Desig. Use Threat	Parameter Name	Parameter Threatened (Y/N)	Parameter Category*	TMDL Schedule	Expected To Attain Date	Source Name (Impairments only)
Aquatic Life	3-ND		Benthic-Macroinvertebrate Bioassessments (Streams)	N	3-ND			
			Dissolved oxygen saturation	N	3-ND			
			Fishes Bioassessments (Streams)	N	3-ND			
			Oxygen, Dissolved	N	3-ND			
			pH	N	3-ND			
Drinking Water After Adequate Treatment	2-G							
Fish Consumption	4A-M		Mercury	N	4A-M			Atmospheric Deposition - Toxics
Primary Contact Recreation	3-ND		Escherichia coli	N	3-ND			
Secondary Contact Recreation	3-ND		Escherichia coli	N	3-ND			
Wildlife	3-ND							

Severe	Poor	Likely Bad	No Data	Likely Good	Marginal	Good
Not Supporting, Severe	Not Supporting, Marginal	Insufficient Information – Potentially Not Supporting	No Data	Insufficient Information – Potentially Full Supporting	Full Support, Marginal	Full Support, Good

*DES Categories; 2-G = Supports Parameter well above criteria, 2-M = Supports Parameter marginally above criteria, 2-OBS = Exceeds WQ criteria but natural therefore not a WQ exceedence, 3-ND = Insufficient Information/No data, 3-PAS= Insufficient Information/Potentially Attaining Standard, 3-PNS= Insufficient Information/Potentially Not Attaining Standard, (4A=Impaired/TMDL Completed, 4B=Impaired/Other Measure will rectify Impairment, 4C=Impaired/Non-Pollutant, 5=Impaired/TMDL needed) M=Marginal Impairment, P=Severe Impairment, T=Threatened (http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm)

Project: File: nhbedata\projects\52281.00 C203 Tap Project\GIS\Project\FinalFigures\USGS_ProjectLocation.mxd
Last Updated 1/15/2014 6:06:55 PM & Revisions: DEA



Legend
- Existing Transmission Line
- Proposed C203 Tap Line
- Project Parcels
- Assessor's Tax Parcels
- Littleton Substation

NEW C203 230KV TAP LINE

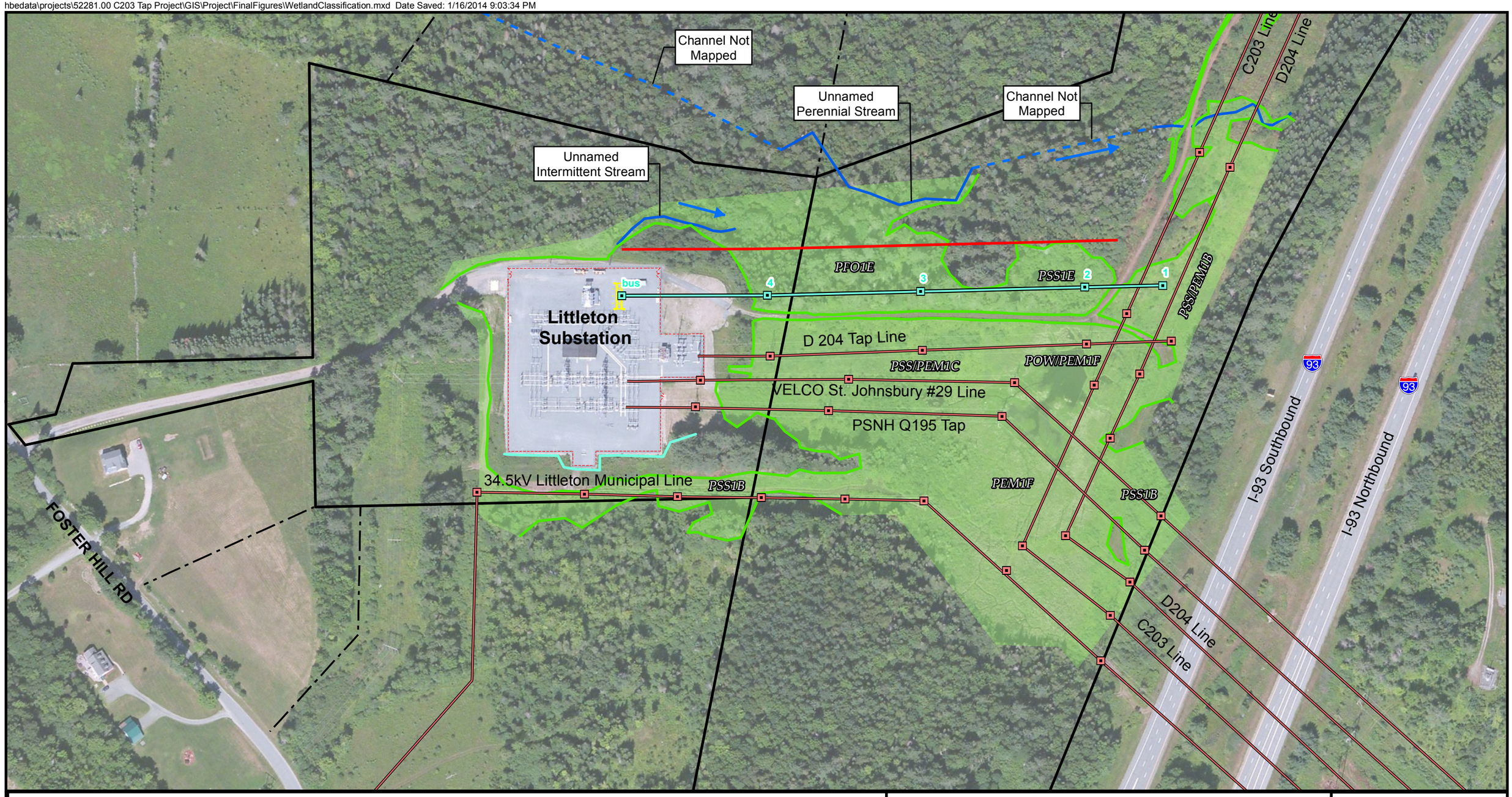
Figure 1 - USGS Site Location Map
Foster Hill Road
Littleton, New Hampshire

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

Path: \
hbedata\projects\52281.00 C203 Tap Project\GIS\Project\FinalFigures\WetlandClassification.mxd Date Saved: 1/16/2014 9:03:34 PM



- Proposed C203 Tap Structure
- Existing Structure
- Proposed C203 Tap Line
- Existing Transmission Line
- Proposed ROW/Edge of Tree Clearing
- Existing Fence Line
- bus
- Delineated Wetland Edge
- Wetland Resource Area
- Ditch
- Stream
- Stream Channel Not Mapped
- Property Line
- Abutter Property Line

Source:
NGRID T-SHEETS
Existing Survey, VHB

0 200 400 Feet

NEW C203 New 230 kV Tap Line

Figure 2 Project Area Wetlands Map
Foster Hill Road
Littleton, New Hampshire

nationalgrid

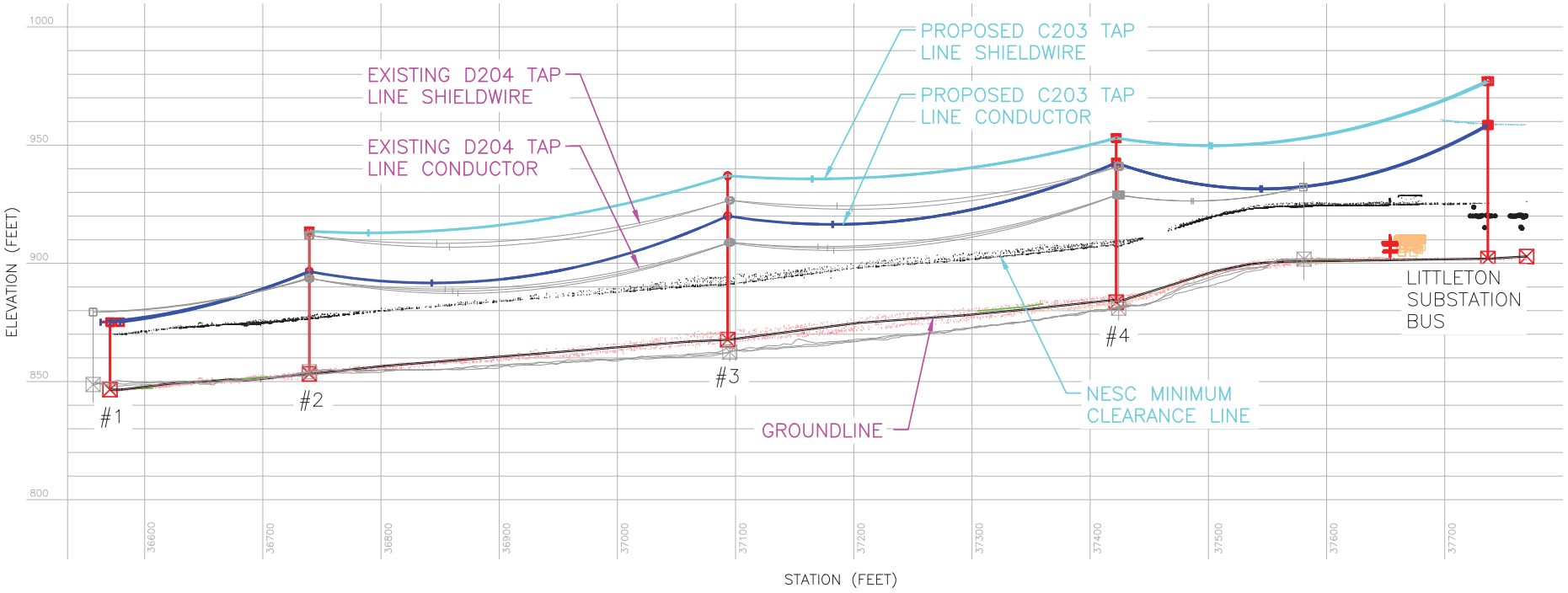
VHB
Vanasse Hangen Brustlin, Inc.

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

Appendix K

Current Design Plan

114006-C-R-01



100 FT HORIZ. SCALE

50 FT VERT. SCALE

C203 & D204 PROFILE VIEW (APPROX. 0.2 MILES)

PROPOSED C203 TAP WIRE
CONDUCTOR: 795 ACSR "DRAKE"
SHIELDWIRE: (2) 3/8" EHS STEEL

230 KV, NEW C203 TAP
NEW TAP LINE BETWEEN C203 MAINLINE AND LITTLETON SUBSTATION (STR. 1 TO LITTLETON SUB)
PROFILE DRAWING

VER	DATE	VERSION DESCRIPTION
1	1/29/14	INITIAL RELEASE

PREPARED BY: CJB 1/29/14
REVIEWED BY:
APPROVED BY:
SCALE:
SHEET 1 OF 1
INDEX

nationalgrid

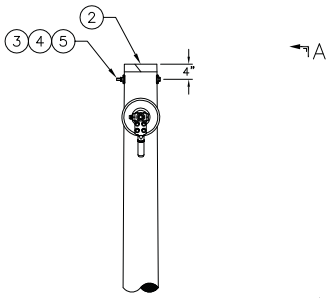
VERSION 1

PRINTED 1/30/2014 3:59 PM

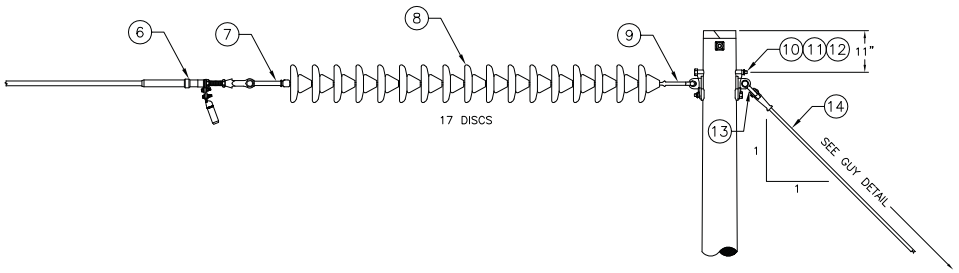
INCHES ON ORIGINAL

114006-C-R-01

114006-C-S-01

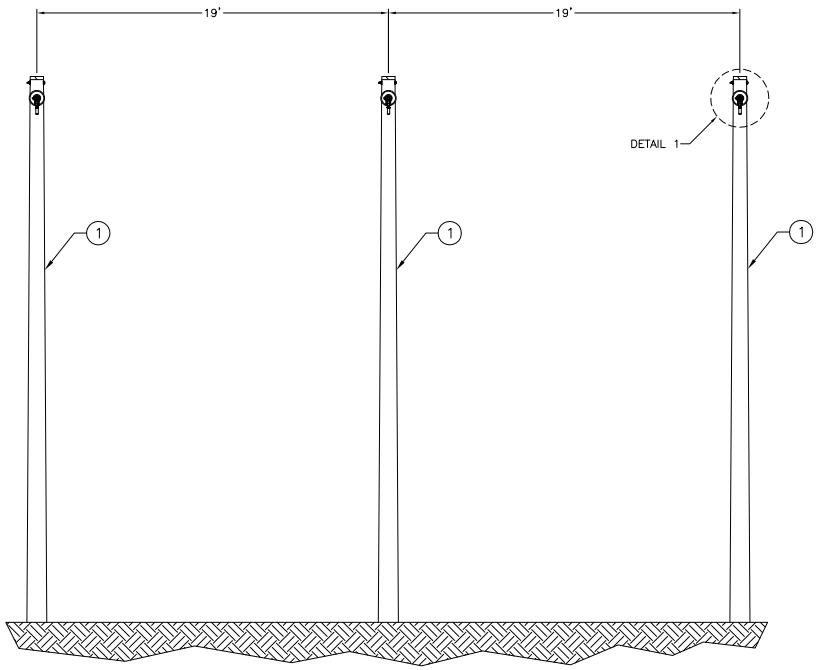


DETAIL 1
TYPICAL 3 PLACES

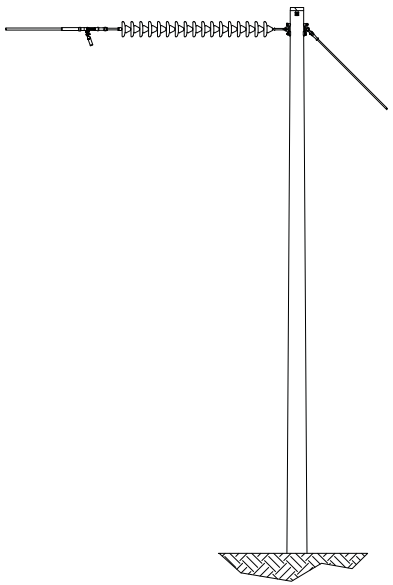


SECTION A–A

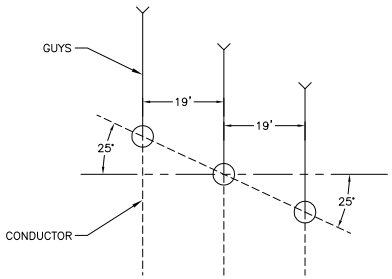
MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
1	3	POLE, WOOD, 35' CLASS 2	9309890
2	3	POLE TOPPER	9307970
3	3	BOLT, MACHINE, GALVANIZED, 5/8"x12"	9320033
4	3	LOCKNUT, FOR 5/8" BOLT	9322021
5	6	WASHER, SQUARE CURVED FOR 5/8" BOLT	9306399
6	3	DEADEND, COMPRESSION ASSY., 795 ACSR "DRAKE"	9308006
7	3	HOTLINE SOCKET EYE, 1" EYE	9305993
8	51	INSULATOR, PORCELAIN DISC, 30K BROWN	9311710
9	3	HOTLINE Y-CLEVIS BALL	9312243
10	6	PLATE, POLE EYE, 36K	9307178
11	6	BOLT, MACHINE, GALVANIZED, 3/4"x16"	9319786
12	6	LOCKNUT FOR 3/4" BOLT	9322023
13	3	ANCHOR SHACKLE, 60K	9307404
14	3	INSULATOR, FIBERGLASS GUY STRAIN, 78"	9307240
15	6	GUY GRIP, 7#6 ALUMOWELD	9320256
16	120	WIRE, GUY, 7#6 ALUMOWELD	9306397
17	3	MARKER, YELLOW GUY	9313584



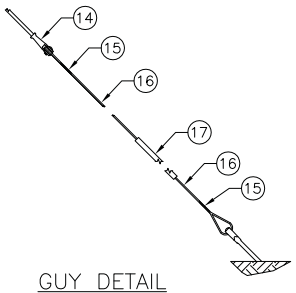
FRONT ELEVATION



SIDE ELEVATION



STAKING DETAIL



GUY DETAIL

NOTES:
1. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.201 FOR SIGNAGE REQUIREMENTS.
2. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.101 FOR GROUNDING DETAILS.
3. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.401 FOR INSTALLATION OF WOOD AND STEEL POLES IN CORRUGATED PIPES.
4. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.402 FOR ANCHOR INSTALLATION DETAILS. REFER TO STRUCTURE WORK LIST FOR ANCHOR TYPE.

VER	DATE	VERSION DESCRIPTION	PREPARED	REVIEWED	APPROVED
1	01/15/14	INITIAL ISSUE	TEC	GJB	
2					
3					
4					
5					
6					
7					

VERSION 1

nationalgrid

PREPARED BY	TEC	11/12/13
REVIEWED BY	GJB	11/15/13
APPROVED BY		
SCALE	NTS	
SHEET	1 OF 1	
INDEX	114006	

230kV, C203 TAP TO LITTLETON SUB

WOOD, 3 POLE, TERMINAL DEADEND

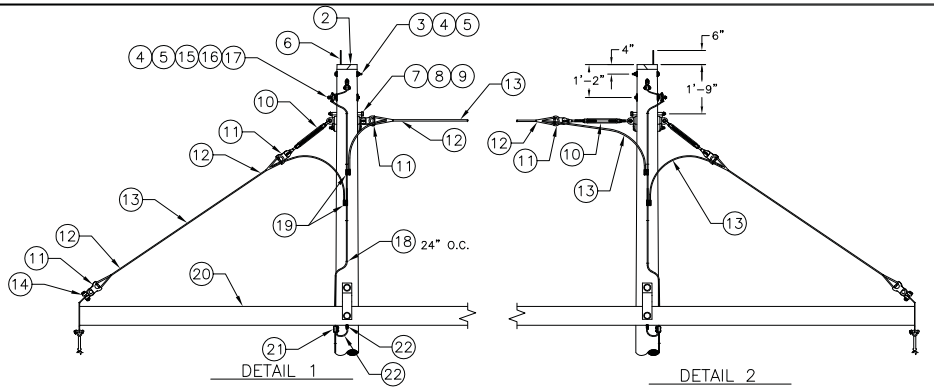
PRINTED 1/22/2014 3:06 PM

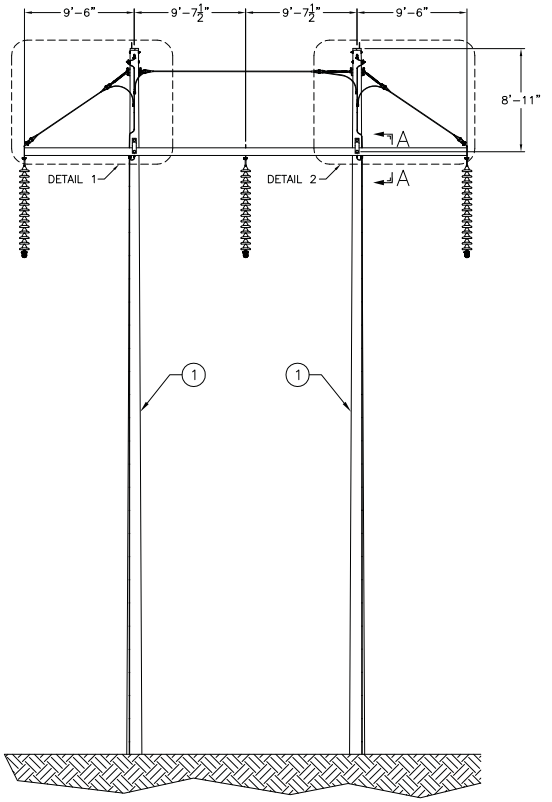
PRINTED COPIES ARE NOT DOCUMENT CONTROLLED. FOR THE LATEST AUTHORIZED VERSION PLEASE REFER TO THE ENGINEERING DEPARTMENT DOCUMENTS CABINET IN DOCUMENTUM

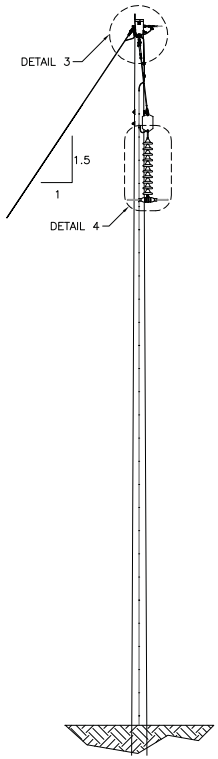
INCHES ON ORIGINAL

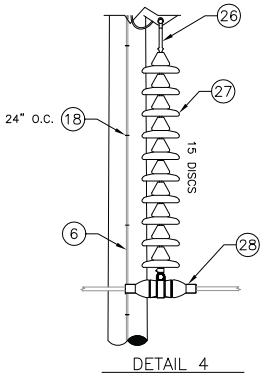
114006-C-S-01

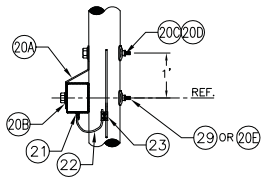
114006-C-S-02

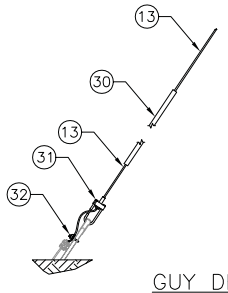












MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
1	2	POLE, WOOD, 70' CLASS 1	9311699
2	2	POLE TOPPER	9307970
3	2	BOLT, MACHINE, GALVANIZED, 5/8"x12"	9320033
4	4	LOCKNUT, FOR 5/8" BOLT	9322021
5	8	WASHER, SQUARE CURVED FOR 5/8" BOLT	9306399
6	150	WIRE, 3/8" STEEL. COMMON GRADE	9306353
7	6	PLATE, POLE EYE, 36K	9307178
8	6	BOLT, MACHINE, GALVANIZED, 3/4"x16"	9319786
9	6	LOCKNUT FOR 3/4" BOLT	9322023
10	3	TURNBUCKLE, JAW AND EYE	9319588
11	8	THIMBLE CLEVIS	9307311
12	8	GUY GRIP, 7#6 ALUMOWELD	9320256
13	225	WIRE, GUY, 7#6 ALUMOWELD	9306397
14	4	ANCHOR SHACKLE, 60K	9307404
15	2	NUT, SQUARE, FOR 5/8" BOLT	9319911
16	2	GROUND CLAMP	9307456
17	2	BOLT, MACHINE, GALVANIZED 5/8"x16"	9320015
18	75	STAPLE, GALVANIZED, 2"	9314525
19	6	CLAMP, PARALLEL GROOVE	9320568
20	1	STEEL CROSSARM, 230kV, 38'-3"	9308431
21	2	PARALLEL GROOVE CLAMP, BRONZE	9320554
22	2	LUG, GROUNDING	9313780
23	8	WIRE, #4 BARE SOLID, COPPER	9316523
24	2	BOLT, SHOULDER EYE, 3/4"x14"	9320619
25	2	CLAMP, COMPRESSION, 3/8" EHS SHIELDWIRE	9306572
26	3	HOTLINE Y-CLEVIS BALL	9312243
27	45	INSULATOR, PORCELAIN DISC, 30K BROWN	9311710
28	3	AGS ASSEMBLY, 795 ACSR "DRAKE"	9320365
29	4	BOLT, MACHINE, GALVANIZED, 1"x20"	9320132
30	2	MARKER, YELLOW GUY	9313584
31	2	AUTOMATIC GUY GRIP, 7#6 ALUMOWELD	9306574
32	2	ANCHOR ROD GROUND CLIP	9320250

SUBASSEMBLY MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
20	1	STEEL CROSSARM, 230kV, 38'-3"	9308431
20A	2	STRAP	
20B	4	WASHER, FLAT	
20C	4	LOCKNUT, FOR 1" BOLT	
20D	4	WASHER, SQUARE CURVED	
20E	4	BOLT, 1"	

NOTES:
1. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.201 FOR SIGNAGE REQUIREMENTS.
2. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.101 FOR GROUNDING DETAILS.
3. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.401 FOR INSTALLATION OF WOOD AND STEEL POLES IN CORRUGATED PIPES.
4. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.402 FOR ANCHOR INSTALLATION DETAILS. REFER TO STRUCTURE WORK LIST FOR ANCHOR TYPE.

VER	DATE	VERSION DESCRIPTION	PREPARED	REVIEWED	APPROVED
1	01/15/14	INITIAL ISSUE	TEC	GJB	

VERSION 1

nationalgrid

PREPARED BY	TEC	11/12/13
REVIEWED BY	GJB	11/15/13
APPROVED BY		
SCALE	NTS	
SHEET	1 OF 1	
INDEX	114006	

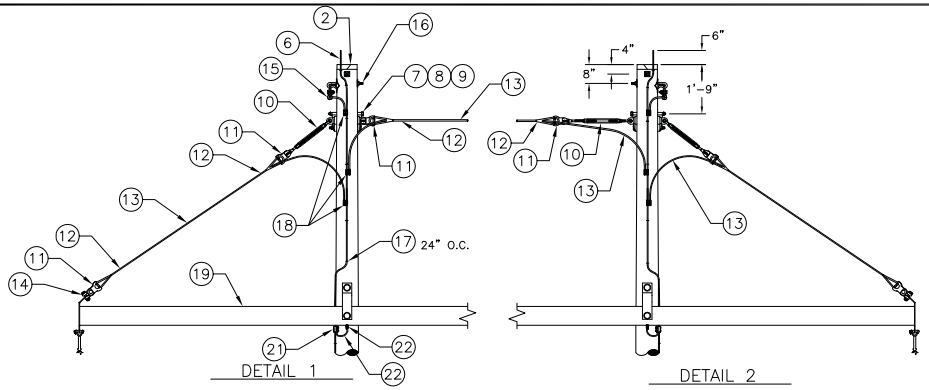
230kV, C203 TAP TO LITTLETON SUB

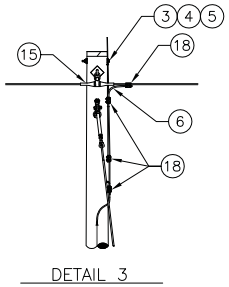
WOOD, H-FRAME SUSPENSION
2 SHIELDWIRE TERMINAL DEADEND

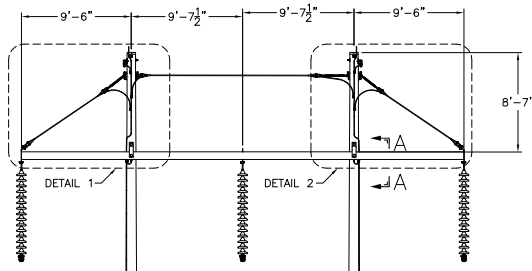
INCHES ON ORIGINAL

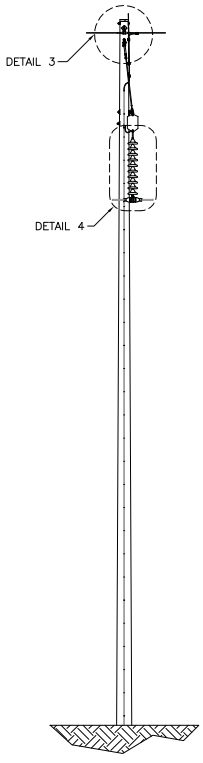
114006-C-S-02

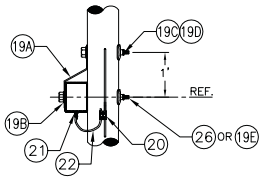
114006-C-S-03



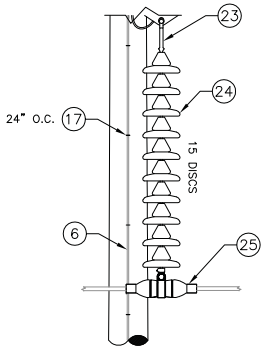








SECTION A–A



DETAIL 4

FRONT ELEVATION

SIDE ELEVATION

MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
1	2	POLE, WOOD, 80' CLASS 1	9311669
2	2	POLE TOPPER	9307970
3	2	BOLT, MACHINE, GALVANIZED, 5/8"x12"	9320033
4	2	LOCKNUT, FOR 5/8" BOLT	9322021
5	4	WASHER, SQUARE CURVED FOR 5/8" BOLT	9306399
6	150	WIRE, 3/8" STEEL. COMMON GRADE	9306353
7	4	PLATE, POLE EYE, 36K	9307178
8	4	BOLT, MACHINE, GALVANIZED, 3/4"x16"	9319786
9	4	LOCKNUT FOR 3/4" BOLT	9322023
10	3	TURNBUCKLE, JAW AND EYE	9319588
11	6	THIMBLE CLEVIS	9307311
12	6	GUY GRIP, 7#6 ALUMOWELD	9320256
13	60	WIRE, GUY, 7#6 ALUMOWELD	9306397
14	2	ANCHOR SHACKLE, 60K	9307404
15	2	AGS, 3/8" EHS, STEEL	9306625
16	2	SHIELDWIRE BRACKET, 5/8"x14"	9313687
17	75	STAPLE, GALVANIZED, 2"	9314525
18	8	CLAMP, PARALLEL GROOVE	9320568
19	1	STEEL CROSSARM, 230kV, 38'-3"	9308431
20	2	PARALLEL GROOVE CLAMP, BRONZE	9320554
21	2	LUG, GROUNDING	9313780
22	8	WIRE, #4 BARE SOLID, COPPER	9316523
23	3	HOTLINE Y-CLEVIS BALL	9312243
24	45	INSULATOR, PORCELAIN DISC, 30K BROWN	9311710
25	3	AGS ASSEMBLY, 795 ACSR "DRAKE"	9320365
26	4	BOLT, MACHINE, GALVANIZED, 1"x20"	9320132

SUBASSEMBLY MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
19	1	STEEL CROSSARM, 230kV, 38'-3"	9308431
19A	2	STRAP	
19B	4	WASHER, FLAT	
19C	4	LOCKNUT, FOR 1" BOLT	
19D	4	WASHER, SQUARE CURVED	
19E	4	BOLT, 1"	

NOTES:
1. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.201 FOR SIGNAGE REQUIREMENTS.
2. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.101 FOR GROUNDING DETAILS.
3. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.401 FOR INSTALLATION OF WOOD AND STEEL POLES IN CORRUGATED PIPES.
4. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.402 FOR ANCHOR INSTALLATION DETAILS. REFER TO STRUCTURE WORK LIST FOR ANCHOR TYPE.

VER	DATE	VERSION DESCRIPTION	PREPARED/REVIEWED/APPROVED
1	01/16/14	INITIAL ISSUE	TEC/GJB

VERSION 1

nationalgrid

PREPARED BY	TEC 11/12/13
REVIEWED BY	GJB 11/15/13
APPROVED BY	
SCALE	NTS
SHEET	1 OF 1
INDEX	114006

230kV, C203 TAP TO LITTLETON SUB

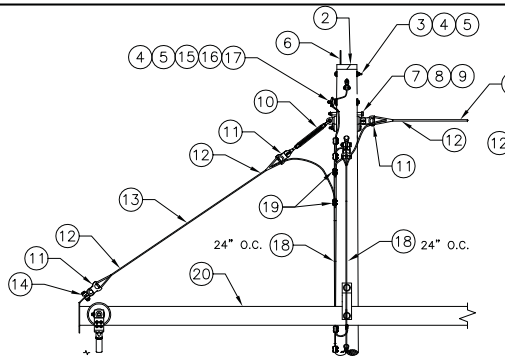
WOOD, H-FRAME SUSPENSION
2 SHIELDWIRE SUSPENSION

PRINTED 1/23/2014 11:31 AM

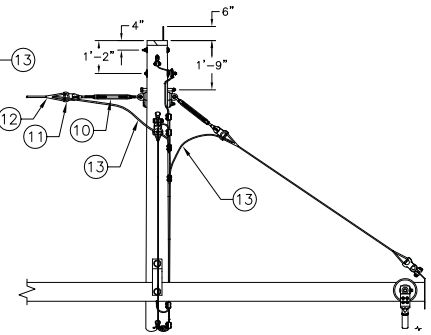
INCHES ON ORIGINAL

114006-C-S-03

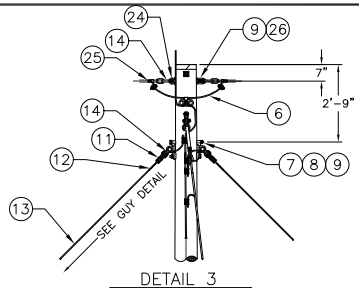
114006-C-S-04



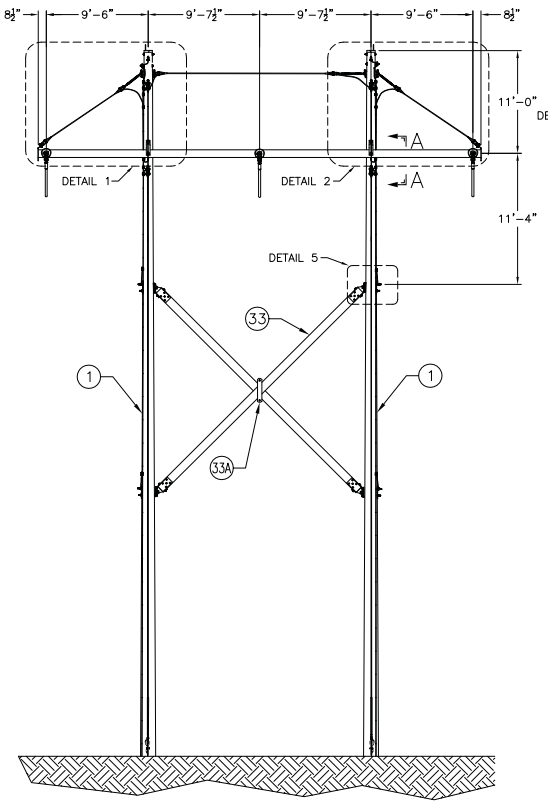
DETAIL 1

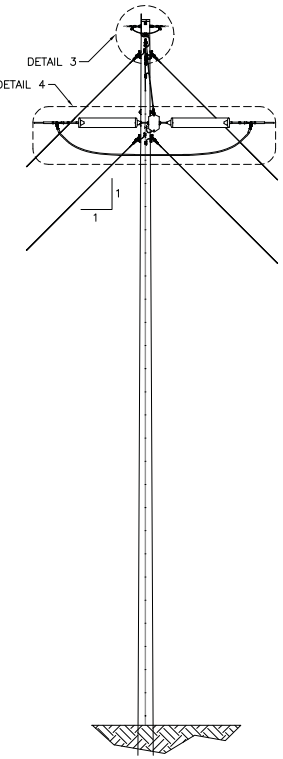


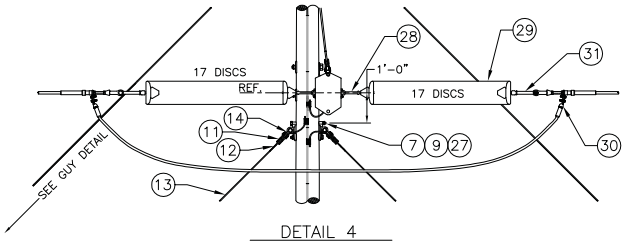
DETAIL 2



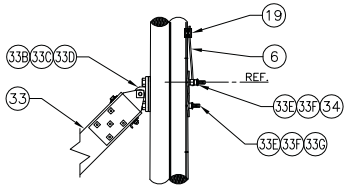
DETAIL 3



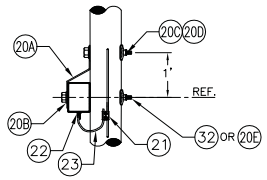




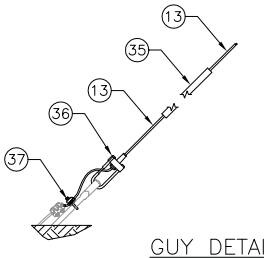
DETAIL 4



DETAIL 5
TYPICAL 4 PLACES



SECTION A-A



GUY DETAIL
TYPICAL 8 PLACES

FRONT ELEVATION

SIDE ELEVATION

MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
1	2	POLE, WOOD, 80' CLASS 1	9311669
2	2	POLE TOPPER	9307970
3	2	BOLT, MACHINE, GALVANIZED, 5/8"x12"	9320033
4	6	LOCKNUT, FOR 5/8" BOLT	9322021
5	8	WASHER, SQUARE CURVED FOR 5/8" BOLT	9306399
6	150	WIRE, 3/8" STEEL. COMMON GRADE	9306353
7	12	PLATE, POLE EYE, 36K	9307178
8	8	BOLT, MACHINE, GALVANIZED, 3/4"x16"	9319786
9	14	LOCKNUT FOR 3/4" BOLT	9322023
10	3	TURNBUCKLE, JAW AND EYE	9319588
11	14	THIMBLE CLEVIS	9307311
12	14	GUY GRIP, 7#6 ALUMOWELD	9320256
13	800	WIRE, GUY, 7#6 ALUMOWELD	9306397
14	14	ANCHOR SHACKLE, 60K	9307404
15	2	NUT, SQUARE, FOR 5/8" BOLT	9319911
16	2	GROUND CLAMP	9307456
17	2	BOLT, MACHINE, GALVANIZED 5/8"x16"	9320015
18	75	STAPLE, GALVANIZED, 2"	9314525
19	16	CLAMP, PARALLEL GROOVE	9320568
20	1	STEEL CROSSARM, 230kV, 39'-8"	9308433
21	2	PARALLEL GROOVE CLAMP, BRONZE	9320554
22	2	LUG, GROUNDING	9313780
23	8	WIRE, #4 BARE SOLID, COPPER	9316523
24	2	BOLT, SHOULDER EYE, 3/4"x14"	9320619
25	2	CLAMP, COMPRESSION, 3/8" EHS SHIELDWIRE	9306572
26	2	BOLT EYE, 3/4"	9313557
27	4	BOLT, MACHINE, GALVANIZED, 3/4"x18"	9319844
28	6	HOTLINE Y-CLEVIS BALL	9312243
29	102	INSULATOR, PORCELAIN DISC, 30K BROWN	9311710
30	6	DE COMP. ASSEMBLY, 795 ACSR "DRAKE"	9308006
31	6	HOTLINE SOCKET EYE, 1" EYE	9305993
32	4	BOLT, MACHINE, GALVANIZED, 1"x20"	9320132
33	1	CROSS BRACE ASSY., 19'-6" SPACING, LAMINATED	9306558
34	4	BONDING CLIP, 7/8", WITH LOCKNUT & SQUARE NUT	9313447
35	8	MARKER, YELLOW GUY	9313584
36	8	AUTOMATIC GUY GRIP, 7#6 ALUMOWELD	9306574
37	8	ANCHOR ROD GROUND CLIP	9320250

SUBASSEMBLY MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
20	1	STEEL CROSSARM, 230kV, 39'-8"	9308431
20A	2	STRAP	
20B	4	WASHER, FLAT	
20C	4	LOCKNUT, FOR 1" BOLT	
20D	4	WASHER, SQUARE CURVED	
20E	4	BOLT, 1"	

SUBASSEMBLY MATERIAL LIST			
TAG	QUAN	DESCRIPTION	PART CODE
33	1	CROSS BRACE ASSY., 19'-6" SPACING, LAMINATED	9306558
33A	1	CENTER CLAMP	
33B	4	TEE	
33C	4	GRID GAIN	
33D	4	PIN BOLT	
33E	8	BOLT, MACHINE, 7/8" WITH NUT	
33F	8	WASHER, CURVED, FOR 7/8" BOLT	
33G	8	LOCKNUT FOR 7/8" BOLT	

NOTES:
1. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.201 FOR SIGNAGE REQUIREMENTS.
2. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.101 FOR GROUNDING DETAILS.
3. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.401 FOR INSTALLATION OF WOOD AND STEEL POLES IN CORRUGATED PIPES.
4. SEE SPECIFICATION SP.06.01.301 AND DRAWING SP.06.01.301.402 FOR ANCHOR INSTALLATION DETAILS. REFER TO STRUCTURE WORK LIST FOR ANCHOR TYPE.

VER	DATE	VERSION DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
1	01/28/14	INITIAL ISSUE	TEC	GJB	

VERSION 1

nationalgrid

PREPARED BY	TEC	12/02/13
REVIEWED BY	GJB	
APPROVED BY		
SCALE	NTS	
SHEET	1 OF 1	
INDEX	114006	

230kV, C203 TAP TO LITTLETON SUB

WOOD, H-FRAME DEADEND
2 SHIELDWIRE DEADEND

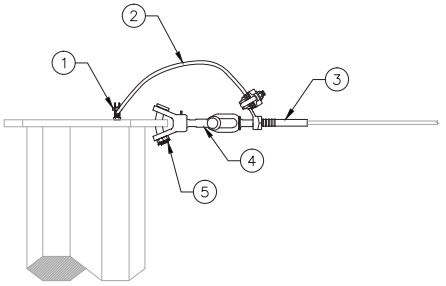
PRINTED 1/22/2014 4:42 PM

PRINTED COPIES ARE NOT DOCUMENT CONTROLLED. FOR THE LATEST AUTHORIZED VERSION PLEASE REFER TO THE ENGINEERING DEPARTMENT DOCUMENTS CABINET IN DOCUMENTUM

INCHES ON ORIGINAL

114006-C-S-04

114006-C-H-01



SHIELDWIRE CONNECTION

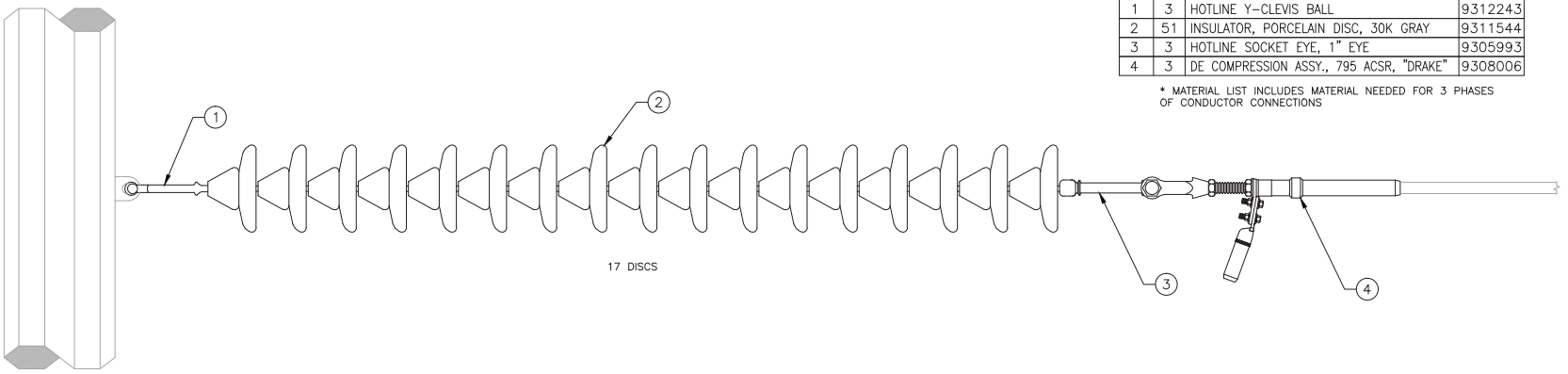
TYPICAL 2 PLACES

MATERIAL LIST – SHIELDWIRE CONNECTION			
TAG	QUAN	DESCRIPTION	PART CODE
1	2	GROUNDING LUG	9313780
2	4	WIRE, 3/8" STEEL, COMMON GRADE	9306353
3	2	CLAMP, COMPRESSION, 3/8" EHS SHIELDWIRE	9306572
4	2	Y-CLEVIS BALL	9312426
5	2	SOCKET Y-CLEVIS	9307402

* MATERIAL LIST INCLUDES MATERIAL NEEDED FOR 2 SHIELDWIRE CONNECTIONS

MATERIAL LIST – CONDUCTOR CONNECTION			
TAG	QUAN	DESCRIPTION	PART CODE
1	3	HOTLINE Y-CLEVIS BALL	9312243
2	51	INSULATOR, PORCELAIN DISC, 30K GRAY	9311544
3	3	HOTLINE SOCKET EYE, 1" EYE	9305993
4	3	DE COMPRESSION ASSY., 795 ACSR, "DRAKE"	9308006

* MATERIAL LIST INCLUDES MATERIAL NEEDED FOR 3 PHASES OF CONDUCTOR CONNECTIONS



CONDUCTOR CONNECTION

TYPICAL 3 PLACES

VER	DATE	VERSION DESCRIPTION	PREPARED/DRAWN	APPROVED
1	11/15/13	INITIAL ISSUE	TEC	GJB
2				
3				
4				
5				
6				
7				

VERSION 1

nationalgrid

PREPARED BY	TEC	11/12/13
REVIEWED BY	GJB	11/15/13
APPROVED BY		
SCALE	NTS	
SHEET	1 OF 1	
INDEX	114006	

230kV, C203 TAP TO LITTLETON SUB

HARDWARE DRAWING
SHIELDWIRE AND CONDUCTOR BUS CONNECTIONS

INCHES ON ORIGINAL

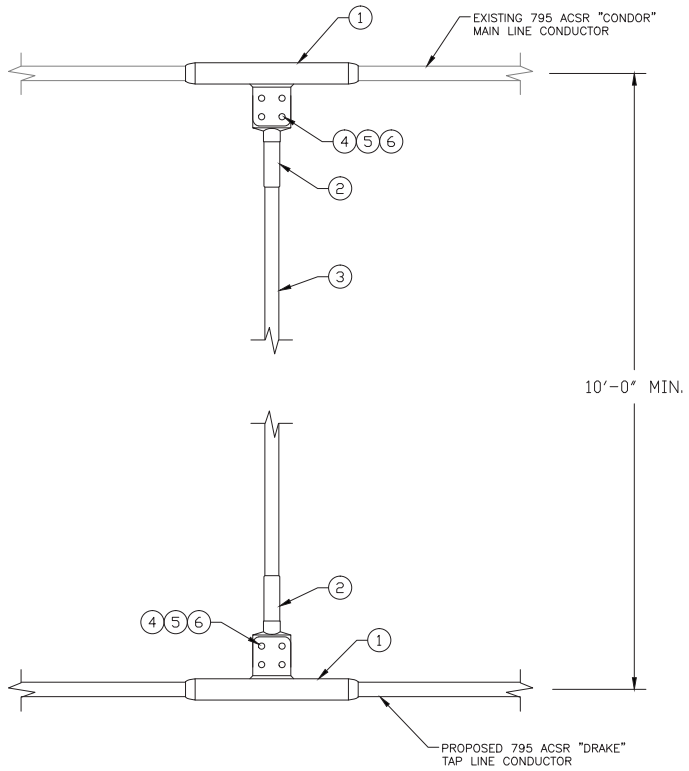
114006-C-H-01

114006-C-H-02

MATERIAL LIST

TAG	QUAN	DESCRIPTION	PS PART CODE	SAP PART CODE
1	2	CONNECTOR, TEE, OPEN RUN, "DRAKE"	5965201	9320042
2	2	CONNECTOR, TERMINAL, 795 ACSR "DRAKE"	5105654	9310811
3	10	795 ACSR "DRAKE" CONDUCTOR	4035224	9315757
4	8	BOLT, MACHINE, 1/2" X 2" GALV.	5983120	9320575
5	8	WASHER, GALV, 1/2" BOLT	7006003	9309339
6	8	NUT, HEX, 1/2", SS	7001719	9319754

NOTES:
1. MATERIAL LIST ITEMS REFLECT QUANTITIES PER PHASE.



ELEVATION

VER	DATE	REVISION DESCRIPTION
1	08/01/13	INITIAL RELEASE
2		
3		
4		
5		
6		
7		

VERSION 1

	ORIGINAL	NAME	DATE
DRAWN		GJB	8/01/13
CHECKED			
REVIEWED			
APPROVED			

nationalgrid

C203 NEW 230KV TAP AT LITTLETON SUBSTATION
HARDWARE DRAWING
230kV TRANSMISSION LINE
TEE TAP CONNECTOR DETAILS

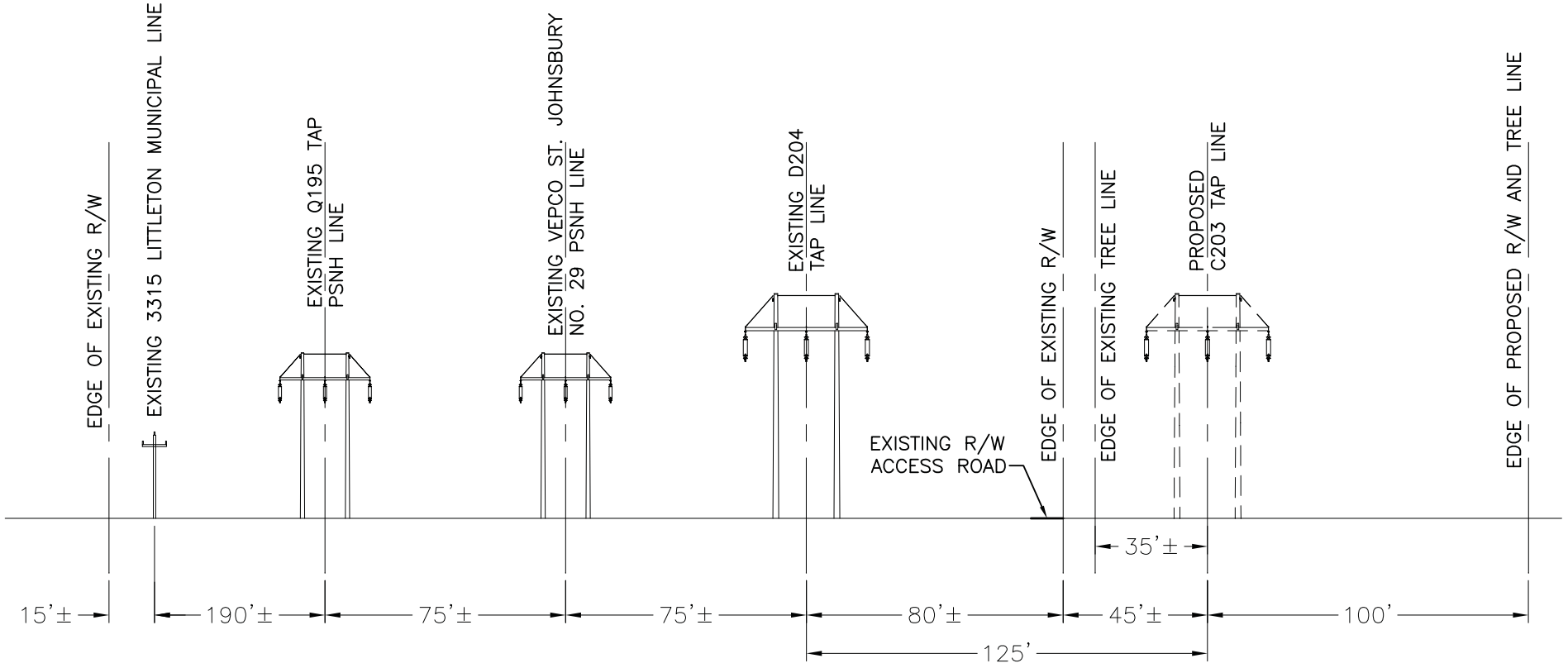
INCHES ON ORIGINAL

114006-C-H-02

PRINTED 1/23/2014 11:53 AM

PRINTED COPIES ARE NOT DOCUMENT CONTROLLED. FOR THE LATEST AUTHORIZED VERSION PLEASE REFER TO THE ENGINEERING DEPARTMENT DOCUMENTS CABINET IN DOCUMENTUM

114006-C-X-01



FACING LITTLETON SUBSTATION
(APPROX. 0.2 MILES)

PROPOSED WIRE
CONDUCTOR: 795 ACSR "DRAKE"
SHIELDWIRE: (2) 3/8" EHS STEEL

VER	DATE	VERSION DESCRIPTION	PREPARED	REVIEWED	APPROVED
1	8/6/13	INITIAL RELEASE	CJB		
2	11/19/14	REVISED FOR DESIGN PACKAGE	CJB		
3					
4					
5					
6					
7					

VERSION 2

nationalgrid

PREPARED BY	CJB	08/28/13
REVIEWED BY		
APPROVED BY		
SCALE		
SHEET	1 OF 1	
INDEX		

230 KV, NEW C203 TAP
NEW TAP LINE BETWEEN C203 MAINLINE AND LITTLETON SUBSTATION (STR. 1 TO LITTLETON SUB)
PROPOSED R/W CROSS SECTION

INCHES ON ORIGINAL

114006-C-X-01

PRINTED COPIES ARE NOT DOCUMENT CONTROLLED. FOR THE LATEST AUTHORIZED VERSION PLEASE REFER TO THE ENGINEERING DEPARTMENT DOCUMENTS CABINET IN DOCUMENTUM

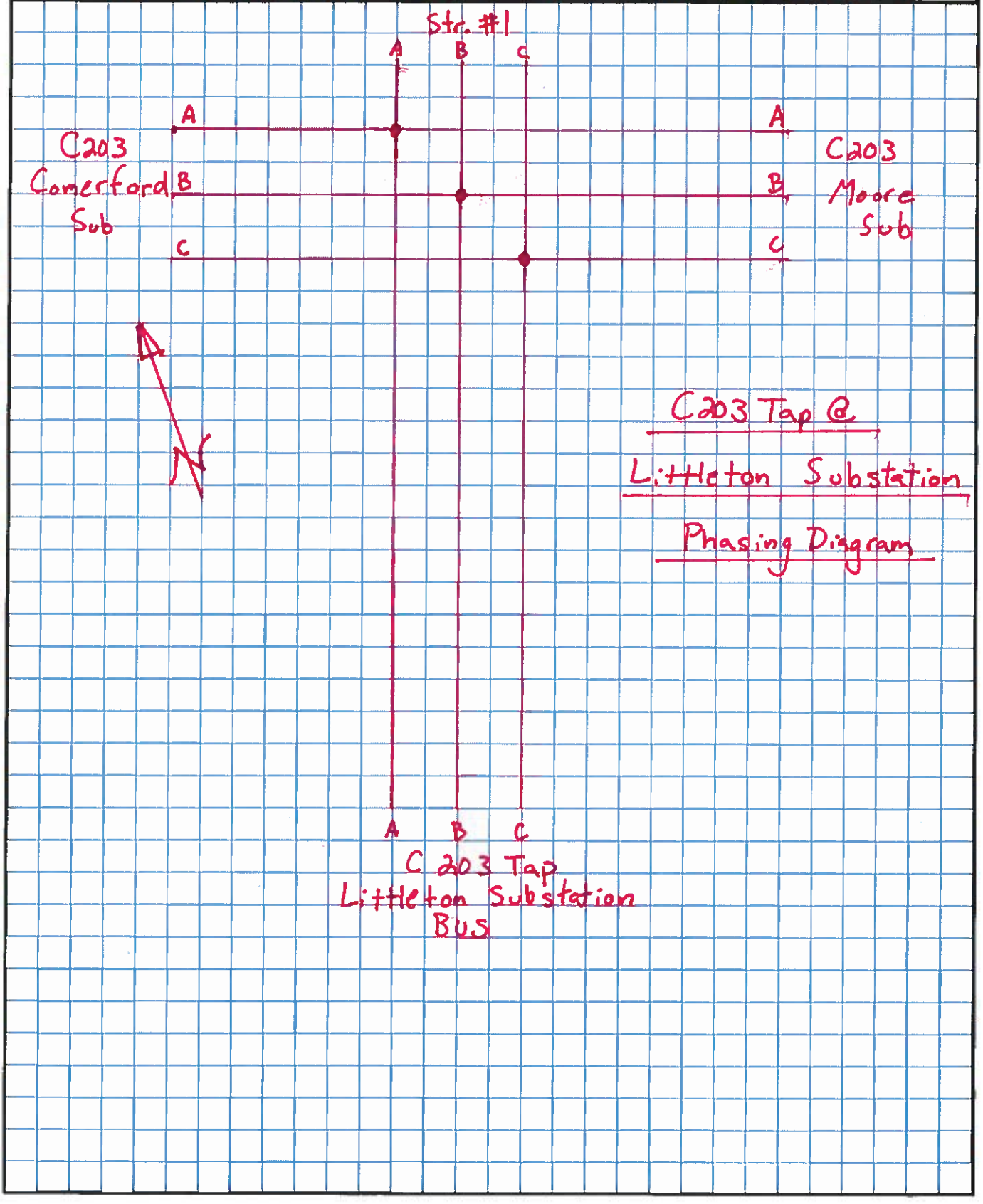
PRINTED 1/23/2014 12:11 PM

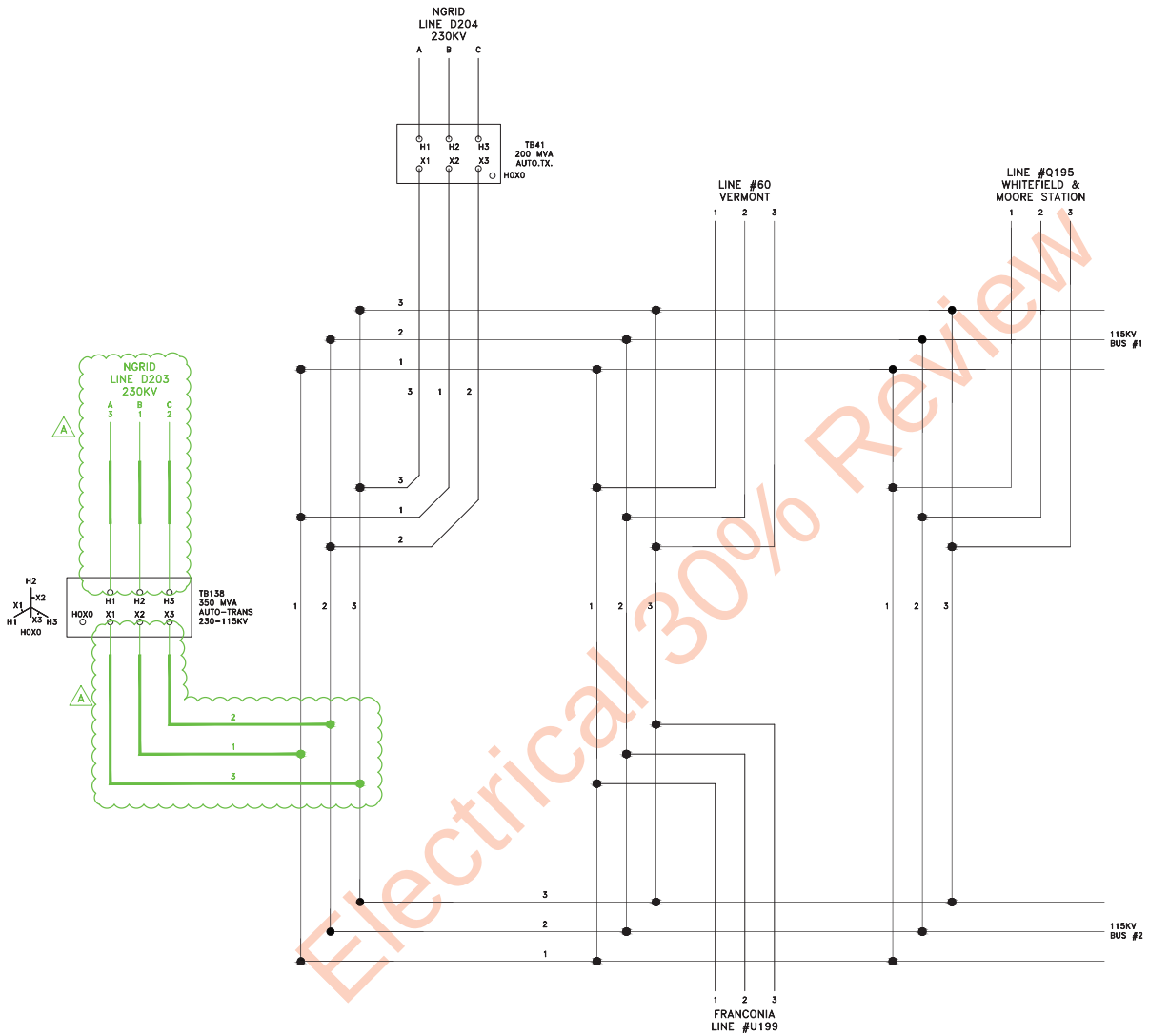
nationalgrid

Date: 8/23/13 | Page 1 of 1

Project Title: C203 Tap to Littleton Sub

Calc by: GJB | Checked by:





NOTES:

1. THIS DRAWING SUPERSEDES MANUAL DRAWING A-572-4 REV.2.

REFERENCES:

D-572-5.1 POWER ONE LINE DIAGRAM
R-572-1 GENERAL ARRANGEMENT PLAN

PRELIMINARY
DESIGN FOR CLIENT REVIEW
NOT FOR CONSTRUCTION

ADDITIONS

NO REMOVAL DRAWING REQUIRED

PHASE RELATIONSHIP:

NGRID	PSNH
A	3
B	1
C	2

REV	DESCRIPTION	ENG/PE#	DATE	DRN	CHKD	APPR
A	30% – SS REVIEW – T1247A1 – EPNB245		03/21/13	RKA	JAG	
4	T1178A1–RECONFIGURATION PROJECT – AS-BUILT	GLB/11903	05/02/11	REF	JLL	GLB
3	T1178A1–RECONFIGURATION PROJECT–IFC	GLB/11903	09/17/10	REF	JLL	GLB
2	REVISED		04/16/75	WRL		
1	REVISED ADDED #2 BUS		05/14/72	WRL		
DRG REV	EPN/DESCRIPTION	CONT/PE#	DATE	DRN	CHKD	APPR

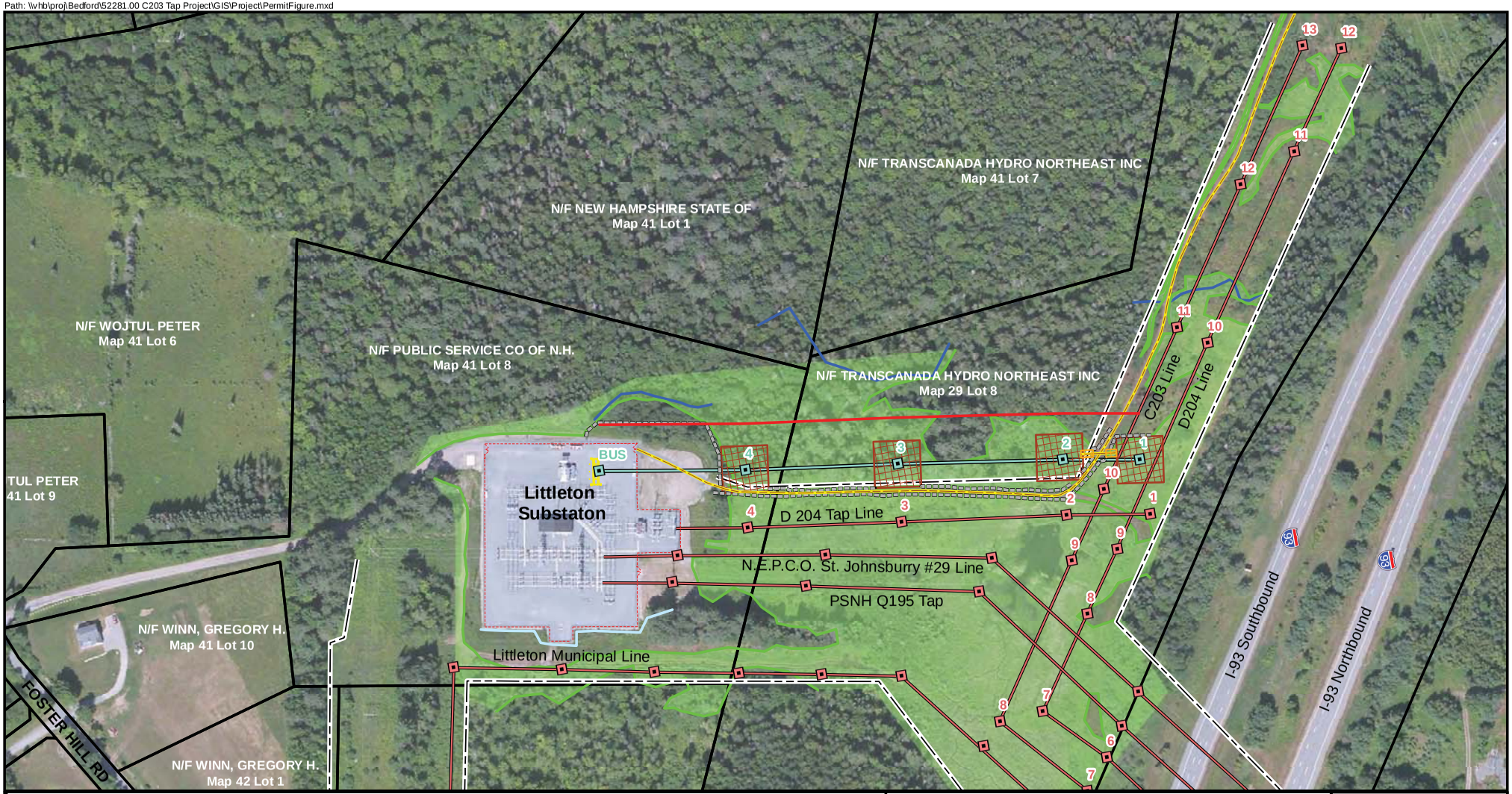
TRC
249 WESTERN AVENUE
AUGUSTA, ME 04330
PROJECT NO: 198756

Public Service of New Hampshire
A Northeast Utilities Company

LITTLETON
230/115KV S/S
PHASING DIAGRAM

T 4
DRAWN RGP
ENGINEER RCF
CHECKED
APPROVED RCF
DATE 03/17/71
SCALE N.T.S.
FILE: A-572-4.DWG
IMAGE:
DRAWING NO. A-572-4

Path: \\vhb\proj\Bedford\52281.00 C203 Tap Project\GIS\Project\PermitFigure.mxd



C203 New 230 kV Tap Line

Figure 2
Littleton Substation
Foster Hill Road
Littleton, New Hampshire

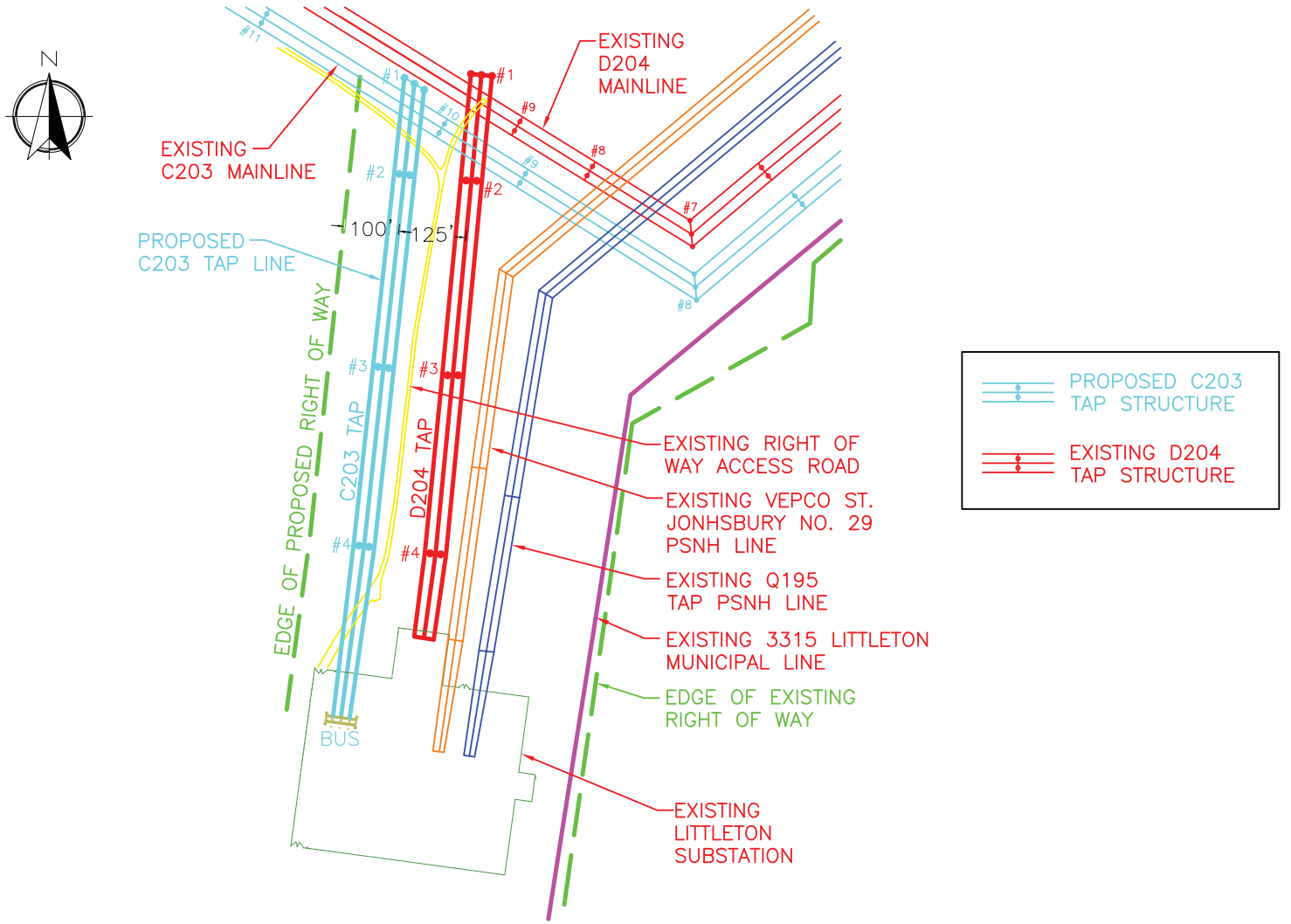
August 22, 2013

nationalgrid

Vanasse Hangen Brustlin, Inc.

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

114006-C-L-01



PLAN VIEW

C203 NEW 230KV TAP AT LITTLETON SUB

LOCUS MAP

VER	DATE	VERSION DESCRIPTION
1	7/16/13	INITIAL RELEASE
2		
3		
4		
5		
6		
7		

VERSION 1

PREPARED BY: GJB 7/16/13
REVIEWED BY:
APPROVED BY:
SCALE: 1
SHEET: 1 OF 1
PROJECT: 114006

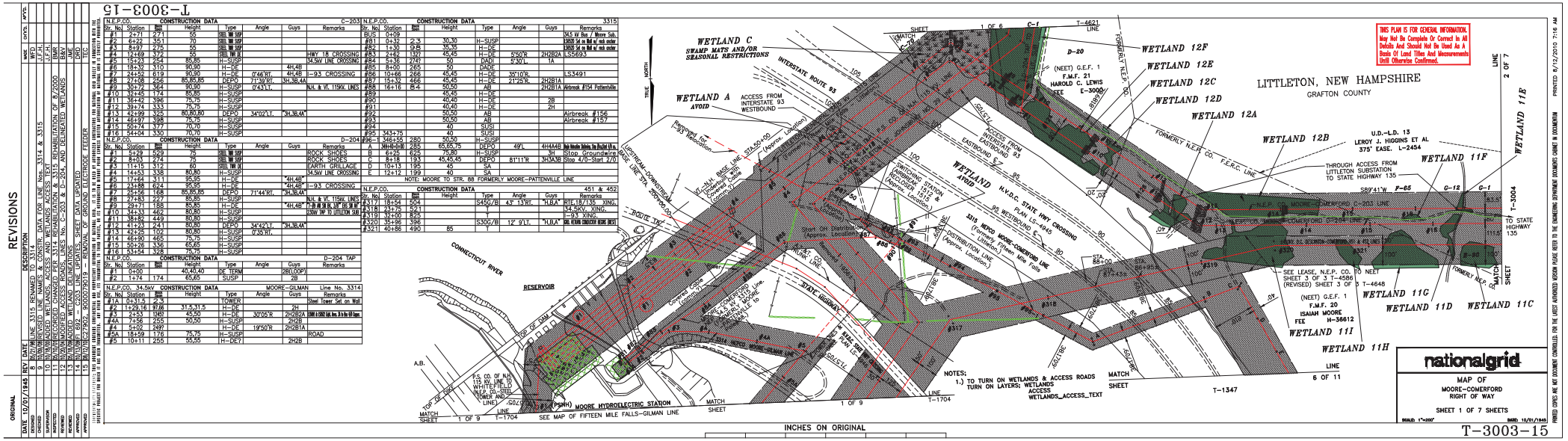
nationalgrid

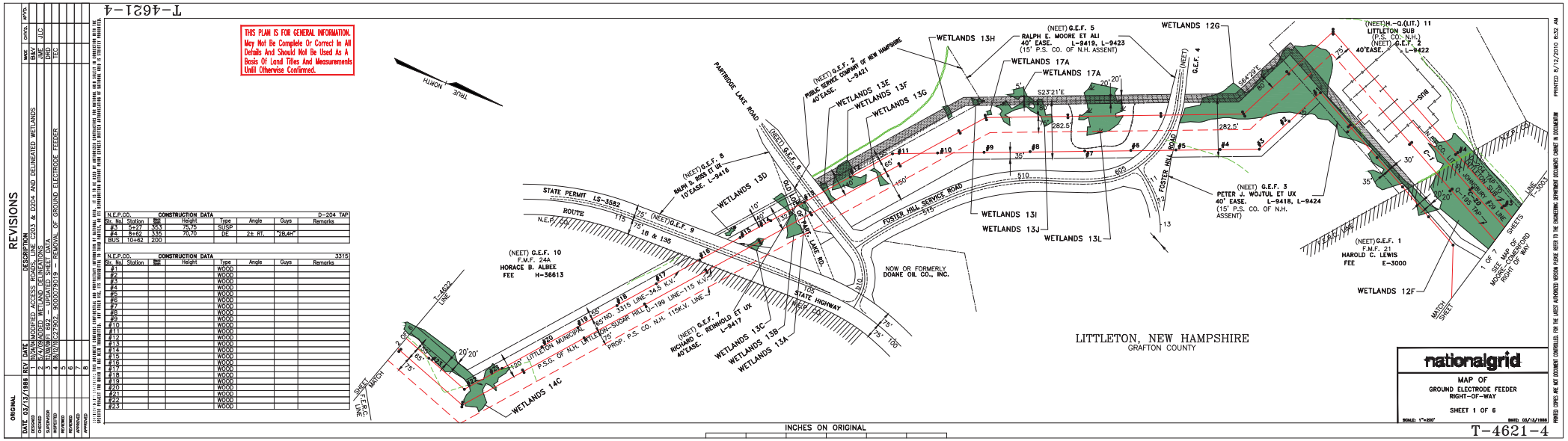
PRINTED 1/22/2014 3:22 PM

PRINTED COPIES ARE NOT DOCUMENT CONTROLLED. FOR THE LATEST AUTHORIZED VERSION PLEASE REFER TO THE ENGINEERING DEPARTMENT DOCUMENTS CABINET IN DOCUMENTUM

INCHES ON ORIGINAL

114006-C-L-01


T-3003-15
REVISIONS
ORIGINAL
DATE 10/01/1945
DESCRIPTION
WFD
U.F.H.
D&V
JME
TEC
WETLAND C
SWAMP MATS AND/OR SEASONAL RESTRICTIONS
WETLAND A
AVOID
ACCESS FROM INTERSTATE 93 WESTBOUND
INTERSTATE ROUTE 93
WETLAND 12F
WETLAND 12E
WETLAND 12C
WETLAND 12D
WETLAND 12A
WETLAND 12B
WETLAND 11F
WETLAND 11E
WETLAND 11G
WETLAND 11D
WETLAND 11C
WETLAND 11I
WETLAND 11H
LITTLETON, NEW HAMPSHIRE
GRAFTON COUNTY
THIS PLAN IS FOR GENERAL INFORMATION. May Not Be Complete Or Correct In All Details And Should Not Be Used As A Basis Of Land Titles And Measurements Until Otherwise Confirmed.
U.D.-L.D. 13
LEROY J. HIGGINS ET AL
375' EASE. L-2454
THROUGH ACCESS FROM LITTLETON SUBSTATION TO STATE HIGHWAY 135
TO STATE HIGHWAY 135
CONNECTICUT RIVER
RESERVOIR
TOP OF DAM
MOORE HYDROELECTRIC STATION
SEE MAP OF FIFTEEN MILE FALLS-GILMAN LINE
NOTES:
1.) TO TURN ON WETLANDS & ACCESS ROADS TURN ON LAYERS: WETLANDS ACCESS WETLANDS_ACCESS_TEXT
nationalgrid
MAP OF
MOORE-COMERFORD
RIGHT OF WAY
SHEET 1 OF 7 SHEETS
T-3003-15



N.E.P.CO. CONSTRUCTION DATA D-204 TAP

Str. No.	Station	Size	Height	Type	Angle	Guys	Remarks
#3	5+27	WF	75,75	SUSP			
#4	8+62	WF	70,70	DE	2± Rt.	*2B,4H*	
BUS	10+62	200					

N.E.P.CO. CONSTRUCTION DATA 3315

Str. No.	Station	Size	Height	Type	Angle	Guys	Remarks
#1				WOOD			
#2				WOOD			
#3				WOOD			
#4				WOOD			
#5				WOOD			
#6				WOOD			
#7				WOOD			
#8				WOOD			
#9				WOOD			
#10				WOOD			
#11				WOOD			
#12				WOOD			
#13				WOOD			
#14				WOOD			
#15				WOOD			
#16				WOOD			
#17				WOOD			
#18				WOOD			
#19				WOOD			
#20				WOOD			
#21				WOOD			
#22				WOOD			
#23				WOOD			

Appendix L

Visual Impact Report

Visual Impact Report

New 230kV Tap Line
C203 Transmission Line

Littleton, New Hampshire

Prepared for **New England Power Company**
d/b/a National Grid

Prepared by ***VHB*/Vanasse Hangen Brustlin, Inc.**
Bedford, New Hampshire

October 2013

Table of Contents

List of Figures

Vanasse Hangen Brustlin, Inc.

Visual Impact Assessment

1.0 Project Introduction

New England Power Company d/b/a National Grid (NEP) proposes to build a new approximately 0.2-mile 230kV Tap Line off of the C203 line to the Littleton Substation in Littleton, NH ("the Project"). The Project will be composed of four new wood transmission structures. The structures include one (1) 35 foot 3-pole wood terminal dead-end structure (Structure #1), one (1) 70 foot wood H-frame suspension structure (Structure #2), one (1) 80 foot wood H-frame suspension structure (Structure #3), and one (1) 80 foot wood H-frame dead-end structure (Structure #4). Foundation depths will be 5.5 feet, 9 feet and 10 feet, respectively. New overhead conductor will be installed and the line will terminate at a new bus structure located within the existing Littleton Substation.

The proposed Project area is approximately 3.5 acres in size and is located adjacent to an existing right-of-way (ROW) that is already occupied by four transmission lines. The ROW will need to be widened by tree clearing along its entire length so that the edge of the ROW is 100 feet from the centerline of the proposed C203 Tap Line.

In order to address aesthetic concerns, structure spacing and pole sizes for the proposed C203 tap have been designed to mimic the adjacent D204 Tap Line. Therefore the proposed tap contains the same number of structures in the same configuration.

This report provides visualizations of the proposed Project from three main vantage points, describes how these visualizations were developed, and discusses the Project's potential impact on the visual environment.

2.0 Site Description and Setting

The existing Littleton Substation is located at 266 Foster Hill Road, Littleton, NH near Interstate 93 (Styles Bridges Highway). The rural landscape in this area consists primarily of coniferous and deciduous forest land with scattered residential development. The landscape is bisected by numerous existing electrical transmission corridors associated with the Littleton Substation and the Moore Substation. The Moore Substation is a large hydro-electric facility, located approximately 3,500 feet

northeast of the Littleton Substation, on the Moore Reservoir of the Connecticut River. The landscape is further impacted by Interstate 93, a four lane highway which is located just north of the Littleton Substation (See **Figure 1 –USGS Project Location Map**).

The existing cleared tap ROW from the Littleton Substation to the C203/D204 main line ROW corridor is approximately 500 feet in width. There are four (4) existing transmission lines within the tap ROW: the 230kV D204 Tap Line, the 115kV PSNH Q195 Tap Line, VEPCO St. Johnsbury #29 Tap Line, and the 3315 34.5kV Littleton Municipal line (Refer to **Figure 7**).

The existing D204 Tap Line consists of four (4) wood structures. The structure configuration consists of one (1) 3-pole wood tap structure, two (2) wood H-frame suspension structures, and one (1) wood H-frame dead-end structure. The existing poles heights range from 40 feet to 75 feet depending on the structure configuration.

The existing tap ROW is visible from two primary locations: a 700 foot segment of I-93 northbound in the vicinity of Exit 44, and at the entrance to the substation at 266 Foster Hill Road. The Littleton Substation itself is not visible to the public because the view is screened by tall forest stands of white pine and mixed hardwoods. There are residential abutters on either side of the driveway entrance to the substation; however the rear portion of each lot is bordered by vegetation, which again screens a view of the substation and the existing D204 Tap Line structures.

3.0 Development of Visualizations

3.1 Viewshed Analysis

A Project viewshed analysis was developed using ArcGIS® Spatial Analyst, a computer modeling tool developed by Environmental Systems Research Institute, Inc. For purposes of this analysis, the "viewshed" refers to the area on the ground from which any portion of a proposed utility pole is expected to be visible. The viewshed represents the area that would be potentially affected by the Project in terms of the visual environment.

Project and study area data were incorporated into the computer model, including utility pole heights, ground elevation, underlying and surrounding topography and existing vegetation. Information used in the model included USGS digital elevation model (DEM) data, and a digital vegetation (or tree canopy) layer developed for the project vicinity. The DEM represents ten-meter spatial resolution elevation information for the state of New Hampshire. The USGS DEM information is the best available elevation source for the Project area. To create the vegetation layer, mature trees and woodland areas depicted on aerial photographs (2010/2011 high resolution infrared imagery) were manually digitized (hand traced) in ArcGIS, creating a

geographic data layer for inclusion in the computer model. The 2010/2011 infrared, digital aerial photographs, obtained from the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) were flown in the spring of 2010/2011 and selected for use in this analysis because of their image quality and depiction of pre-leaf emergence (i.e., "leaf-off") conditions.

Once the specific data layers were entered, the ArcGIS Spatial Analyst Viewshed tool was applied to achieve an estimate of locations where the four proposed structures (nine individual wood utility poles) could be visible. Initially, only topography was used as a possible visual constraint; the tree canopy was omitted to evaluate potential visibility with no intervening vegetative screening. The resulting topographic viewshed (using topography only) represents a "worst case" scenario of the potential Project visibility, but it provides an opportunity to identify areas within potential direct lines of sight of the proposed structures.

To supplement the topographic viewshed analysis, a vegetation viewshed was also prepared to illustrate the potential screening provided by the surrounding forest vegetation. The vegetation data layer was overlaid and built into the DEM, using a conservative average tree canopy height of 65 feet. The revised DEM or more appropriately termed, digital surface model (DSM) was used to establish an assessment of intervening vegetation and to finalize the viewshed analysis.

Once the viewshed analysis was completed, analysts were able to construct a 3D model of the Project area and perform Line of Sight (LOS) analyses from any point within the study area. The results are presented in **Figure 2 – Project Viewshed Analysis**. In this figure, the shading represents the area at normal observer height (i.e., six feet above the ground surface) where any portion of the new structures would be visible.

The analysis is essentially an integration of a number of LOSs and represents a conservative scenario for a couple of reasons. First, it does not take into account factors such as visual attenuation due to reflections, haze, etc., which would make the actual viewshed smaller than depicted in **Figure 2**. Second, only mature forest stands were included in the vegetation viewshed. Areas of shrub vegetation and individual trees were not taken into consideration of the viewshed analysis. However, because the vegetation viewshed accounts for the screening provided by mapped forest stands, it is a much more accurate representation of potential Project visibility. Thus, for this reason too, the viewshed depicted in **Figure 2** is relatively conservative and likely larger than the actual Project visibility.

3.2 Photographic Simulation

Representative viewpoints were selected and the visual impact of the Project was assessed at each location. The positions of the viewpoints were selected based upon practical considerations for the photomontage process, including safe and legal

access to the viewpoints for taking photographs and establishing associated GPS points. The representative view locations include:

- I-93 northbound just north of Exit 44;
- Looking north from Littleton Substation; and
- Residence located at 290 Foster Hill Road[1]

Figure 3 - Photomontage Locations shows the locations of these three viewpoints.

The process of photo simulation uses digital photographs of existing conditions, which are then modified using a CAD/D model of the proposed Project to represent proposed conditions.

Photographs were taken using a digital SLR with a 50mm lens. GPS equipment was used to establish the position of each photo. The camera settings were set for the conditions at the time of the photograph, but images were adjusted for color, levels and exposure using industry standard software as needed to allow for maximum clarity.

The proposed structures were modeled in three dimensions in CAD/D software. The model is as detailed as necessary to cover all fundamental elements that need to be incorporated in the final photomontage. Rendered images are captured out of the 3D view from the CAD/D software.

Industry standard image handling software was used to produce the final photomontage image. The original image for a viewpoint is the base for the photomontage, plus the images captured from the CAD/D software . The modeled control features on the proposed image were aligned to correlate to their real world equivalents in the photo so as to ensure the modeled development is represented to the correct size and location. The photomontage is produced using the aligned modeled development.

The images captured from the CAD/D software are replaced with equivalent photos to provide a photo realistic image. Colors and lighting conditions for the development are matched to those at the time of the photo. Final images are cropped to the required field of view and saved as .jpg format. Both existing and proposed images are shown at the same size and scale, with all required details displayed. The final images may be printed as paper copies at a suitable resolution for delivery to allow review on site (as required).

The resulting photomontages are presented in **Figures 4, 5** and **6**.

[1] Although two residences abut the project ROW to the south, this residence was chosen because it is topographically higher and therefore far more likely to be able to see the project than the other abutting home which is lower in elevation and located to the west of this residence.

4.0 Assessment of Visual Impacts

The potential visual impact of the Project is a function of two factors:

- Visibility of the proposed structures; and
- Visual absorption capacity of the landscape in which the proposed structures are placed.

"Visibility" is a measure of the extent to which the Project may be visible from surrounding areas, the relative number of viewers, the period of view, the view distance, and the context of the view. The rationale for this aspect of the visual assessment is that if the proposed structures are not visible from a particular area, then the potential visual impact is nil. Similarly, if the number of people who would potentially see the proposed structures is low, then the visual impact would be relatively low compared to a situation in which a large number of people had the same view. The distance to the site is a strong influence on potential visual impact, since the proportion of the total view from a particular location decreases with distance. Thus, views from locations far away from the site will experience less visual impact than closer views.

"Visual absorption capacity" describes the capacity of the landscape to absorb development without creating visual changes that reduce scenic quality. The capacity to absorb development is primarily dependent on vegetation cover, landform, and the presence of other development. "Visual contrast" is increased for views of infrastructure set in a background of undeveloped land. Conversely, visual contrast is typically reduced by the presence of existing infrastructure. If, for example, an area is highly urbanized, then the capacity of that area to visually absorb additional urban development is higher than an area that has an undeveloped natural visual character.

4.1 Visibility of the Project

Figure 2 shows that the Project would be visible only from a limited area. The results of the viewshed analysis show that views of the proposed Tap Line structures are limited to the existing cleared transmission ROWs, and the I-93 crossing. The total area that is visible from the ground is approximately 46 acres, with nearly all of the viewing area (92%) limited to existing transmission ROWs.

The Project viewshed is essentially limited to the existing ROW, which is privately owned and not a location that is accessible to the general public. **Figures 2** and **6** also show that the Project would not be visible from abutting properties.

The primary viewpoint of the Project from the public's perspective occurs along I-93, approximately 1,300 feet from the Project. The period of the view is minimized by travel speeds and direction of the viewpoint. Motorists do not have a direct line of

sight of the Project ROW, so to view the Project ROW motorists need to turn their attention away from the road and look southwest.

4.2 Visual Absorption Capacity

The landscape of the Project area is generally forested and undeveloped, consistent with much of the north country of New Hampshire. Visual and scenic quality is generally very high in this region of the state, with tourism being an important part of the economy. Indeed there are several scenic overlooks in the area surrounding the Project, particularly near the Moore Dam impoundment and the Connecticut River. However, the Project would not be visible from any of these vantage points. In this landscape, development of any kind would have high visual contrast. However, the Project is located within a highly developed electric transmission ROW, which would reduce the actual visual contrast.

4.3 Discussion of Visual Impacts

The proposed Project is not expected to interfere with the aesthetic interests of the general public. The proposed Project is located adjacent to an existing 500 foot wide cleared electrical utility ROW. As proposed, 135 feet of tree clearing along the 0.2 mile Project ROW will take place prior to the installation of the new support structures and overhead Tap Line; however, the design of the proposed Tap Line mimics the adjacent D204 Tap Line and it is not anticipated to significantly alter the appearance from what presently exists today. Furthermore, the Project is not located where it may be readily viewed by the general public.

Additionally, the proposed structure configurations are identical to those that currently exist along the Tap Line ROW and the main line transmission ROWs and the proposed pole heights are no higher than those that currently exist. The location of the proposed C203 Tap Line is also located farthest away from the viewer producing a visual effect where the proposed structures actually appear smaller in size than the structures which presently exist in the Project ROW.

4.3.1 View 1 – Interstate 93

Motorists traveling southbound on I-93 are not able to view the existing Project ROW or the Littleton Substation due to roadside vegetation consisting of a 150 foot wide stand of trees which screen the view of the Project ROW as well as a view of the C203/D204 main line corridor. In addition to the trees along the roadside, a vegetated berm exists where the C203/D204, VEPCO St. Johnsbury #29 Tap Line, and the 3315 34.5kV Littleton Municipal transmission lines cross over I-93 (approximately a 700 foot wide opening), further screening the Project ROW and Littleton Substation. Motorists traveling northbound on I-93 are able to view the northern portion of the Project ROW over the vegetated berm where the ROW

crosses the highway, but the roadside vegetation located on the west side of the southbound travel lanes prevent any additional views of the Project ROW. The Littleton Substation is not visible at any point along I-93. None of this vegetation will be cleared as a result of the proposed C203 Tap Line, and therefore the current view will remain the same post-construction.

Proposed structures 2, 3, and 4 will be partially visible to northbound motorists on I-93 where the ROW crosses the highway. However, because the alignment for C203 Tap Line is proposed along the western most edge of the Project ROW (farthest from the highway); the majority of the proposed structures will be obscured by the existing electrical structures. More specifically, there are 14 existing electrical structures that would obscure the view. Given the amount of existing transmission infrastructure in place at this viewpoint, the visual absorption capacity of the landscape can accommodate the four new proposed structures with little visual impact. Within the 700-foot-wide opening, no more than two proposed structures can be viewed at a time. Structure 1, the 35 foot three-pole terminal dead-end structure, is not visible from any viewpoint along I-93.

The effects of the tree clearing on the existing tree line are almost unnoticeable to the viewer, given the viewing distance (approximately 1,300 ft) and the fact that background view remains as forested land cover. As previously stated, northbound motorists have a limited viewpoint of the Project ROW, which is further reduced by the vehicle speed and the actual amount of time a motorist has to view the ROW. Motorists traveling the posted speed limit (65 miles/hour) would have a seven (7) second view of the Project ROW.

4.3.2 View 2 – Littleton Substation

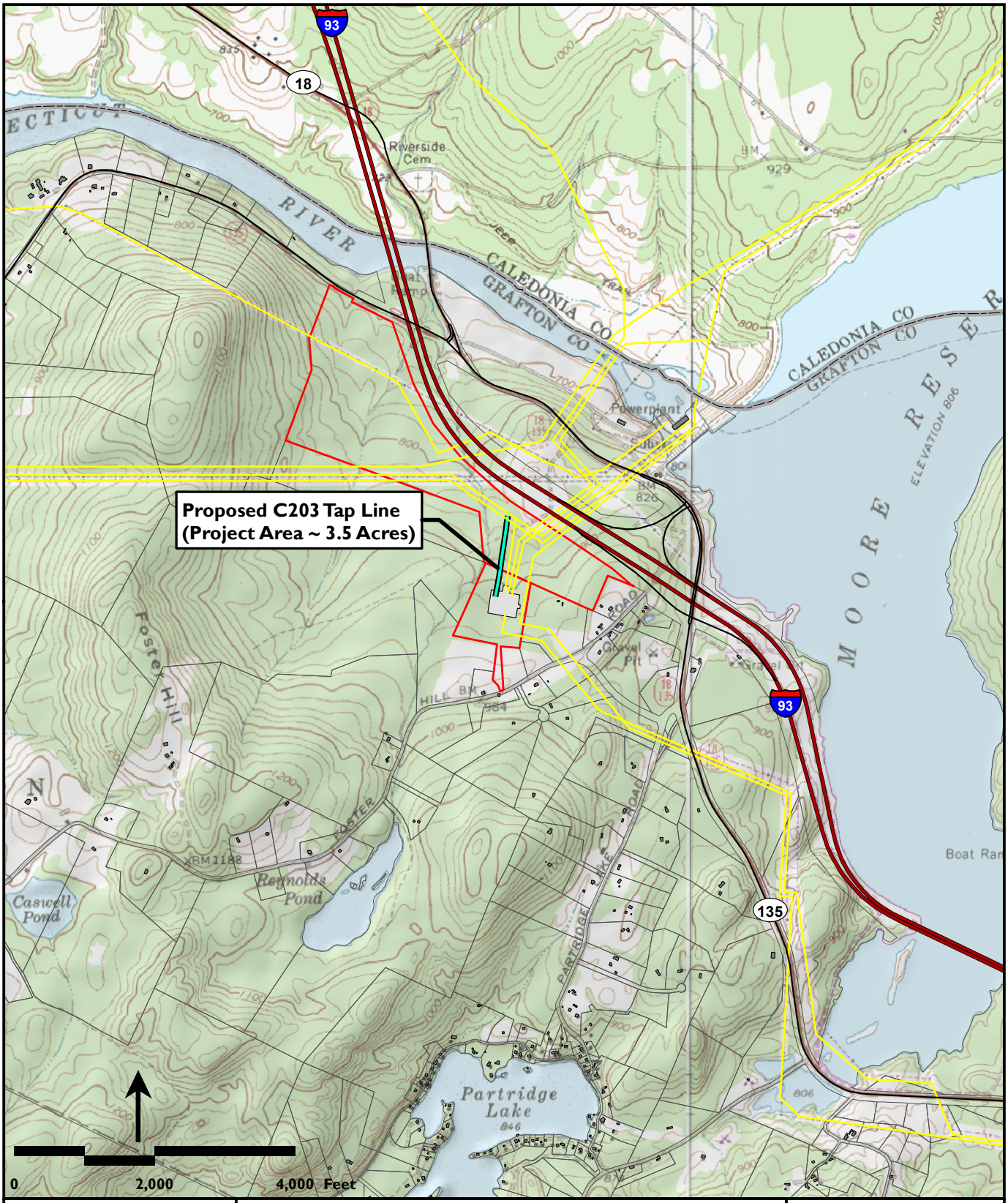
The photomontage viewpoint from the fence line located at the north end of the Littleton Substation provides the best visualization of what the proposed C203 Tap Line would look like, although public access to this area is limited. All four (4) proposed structures are visible and the proposed tree clearing along the west edge of the Project ROW is evident. Even from this viewpoint, the visual impact to viewer is low. One reason for this is that the proposed C203 Tap structures are identical in size and type as the adjacent D204 Tap Line. Similar to the I-93 northbound viewpoint, the visual contrast (size, shape, and material) between the existing structures and the proposed structures is absorbed into the landscape, reducing visual impact to the viewer. The public does not have permission to gain access to the Project ROW given the danger associated with the electrical voltage at the Littleton Substation, so this viewpoint will only be available to transmission company employees.

4.3.3 View 3 – Abutter Property

The abutter property located at 290 Foster Hill Road has no existing view of the Littleton Substation or the existing structures within the Project ROW. However, this location was chosen for the third representative viewpoint, as opposed to the other abutting property (located to the west of this property) because this property is located higher up in elevation and has the greatest potential to have its view impacted by the 135 feet of tree clearing for the proposed C203 Tap Line. As depicted in the photomontage, the 135 feet of tree clearing will have no impact on the abutter's view, nor can any of the structures be seen.

5.0 Conclusion

Based on the fact that the Project site is not generally accessible by or visible to the public except for limited views from I-93, and based on the fact that the Project will be located in an area already developed as an electrical transmission right-of-way, it is concluded that the Project will not have an unreasonable adverse effect on aesthetics.



Legend

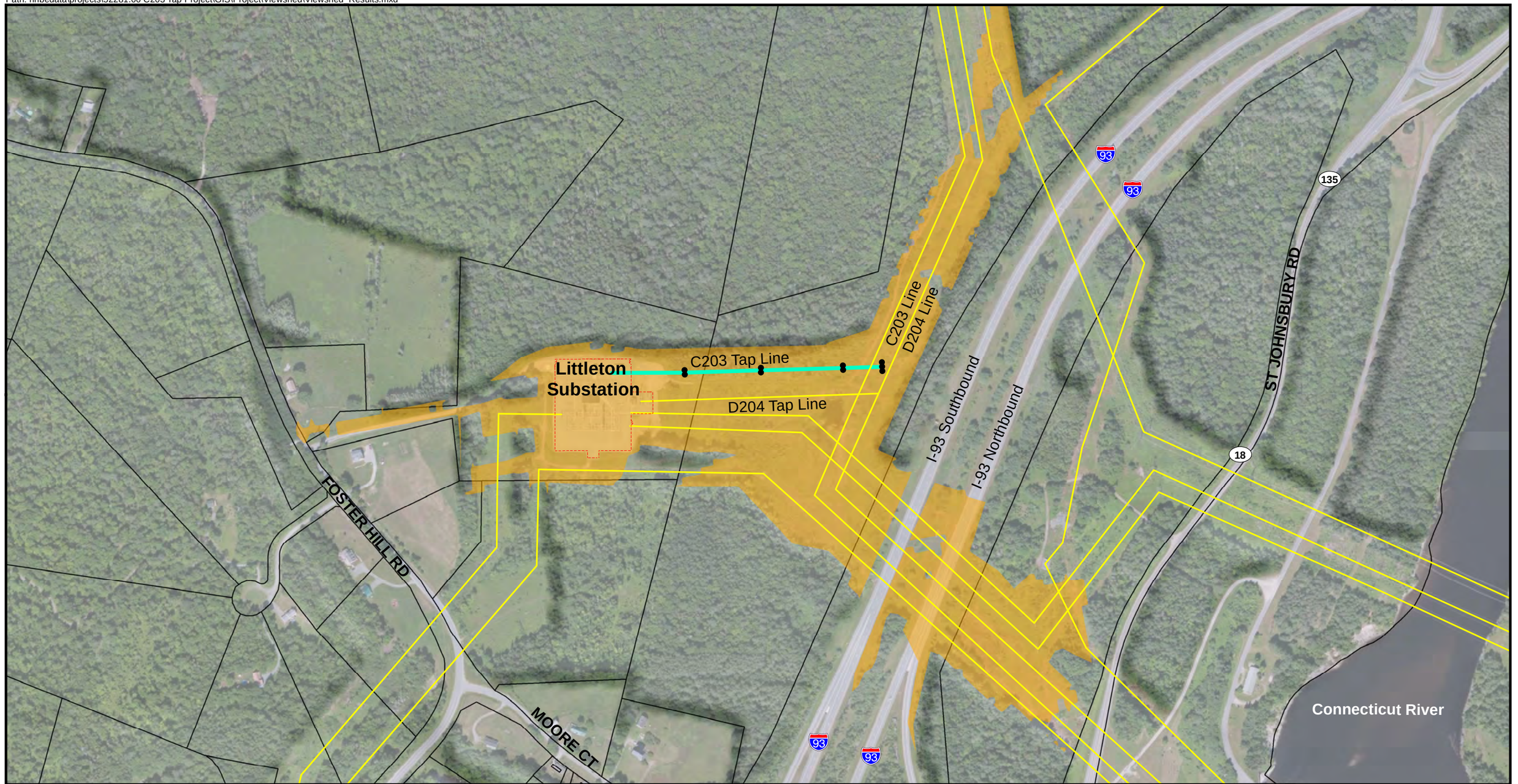
- Existing Transmission Line
- Proposed C203 Tap Line
- Project Parcels
- Assessor's Tax Parcels
- Littleton Substation

NEW C203 230KV TAP LINE

Figure 1 USGS Site Location Map
Foster Hill Road
Littleton, New Hampshire

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.



- Proposed Utility Pole
- Proposed C203 Tap Line
- Structure Visible at Ground Level
- Existing Transmission Line
- Existing Fence Line
- Assessor's Tax Parcels

Source:
NGRID T-SHEETS
VHB

0 400 800 Feet

C203 New 230 kV Tap Line

Figure 2 Project Viewshed Analysis
Littleton Substation
Foster Hill Road
Littleton, New Hampshire

October 18, 2013

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.

Proposed Photomontage Location
Proposed C203 Tap Structure
Existing Structure
Proposed C203 Tap Line
Existing Transmission Line
Existing Treeline (Approximate)
Proposed ROW/Edge of Tree Clearing
Existing Fence Line
Proposed BUS
Assessor's Tax Parcels

Source:
NGRID T-SHEETS
VHB

0 250 500 Feet

C203 New 230 kV Tap Line

Figure 3 Photomontage Locations
Littleton Substation
Foster Hill Road
Littleton, New Hampshire

October 18, 2013

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.

C203 NEW 230KV TAP LINE

Figure 4 Visual Simulation From I-93 Northbound - Existing Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

VHB Vanasse Hangen Brustlin, Inc.

C203 NEW 230KV TAP LINE

Figure 4 Visual Simulation From I-93 Northbound - Proposed Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

VHB Vanasse Hangen Brustlin, Inc.

C203 NEW 230KV TAP LINE

Figure 5 Visual Simulation From the Littleton Substation - Existing Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

VHB Vanasse Hangen Brustlin, Inc.

THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

C203 NEW 230KV TAP LINE

Figure 5 Visual Simulation From the Littleton Substation - Proposed Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

VHB Vanasse Hangen Brustlin, Inc.

C203 NEW 230KV TAP LINE

Figure 6 Visual Simulation From Abutting Residence - Existing Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

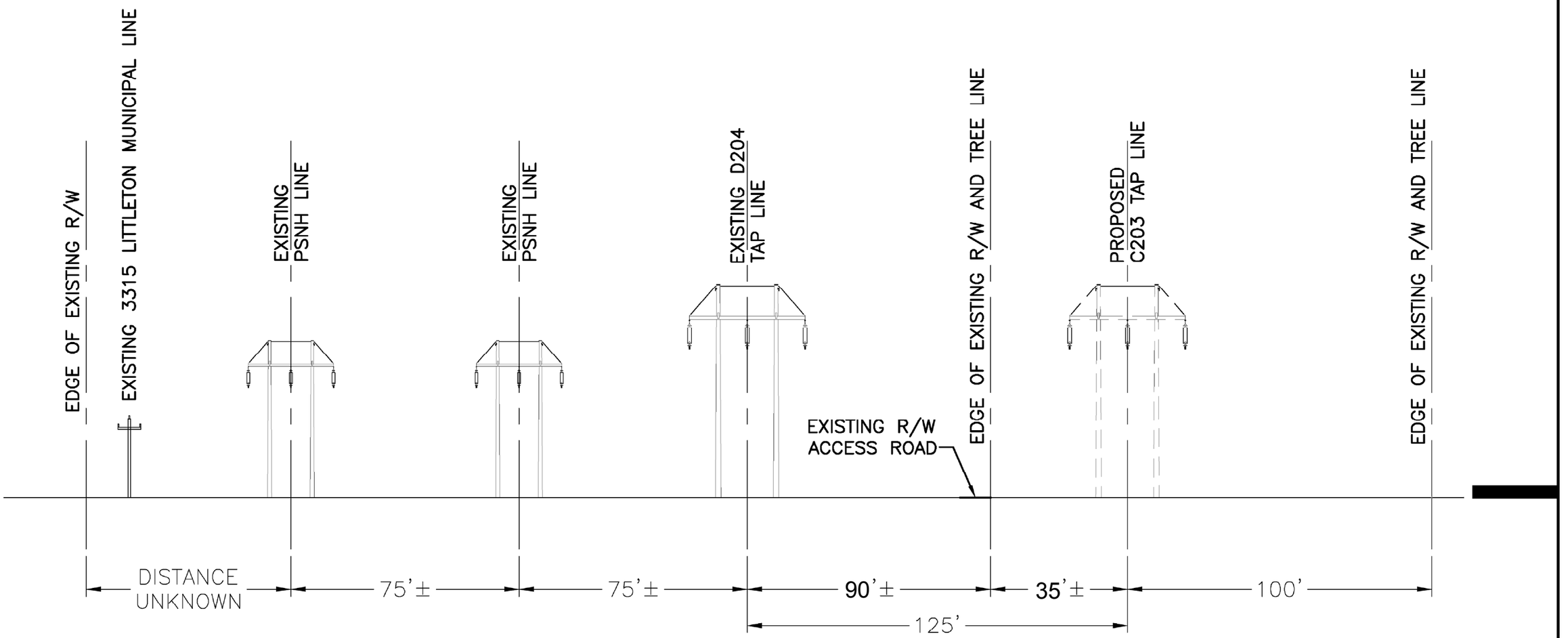
VHB Vanasse Hangen Brustlin, Inc.

C203 NEW 230KV TAP LINE

Figure 6 Visual Simulation From Abutting Residence - Proposed Conditions
Littleton Substation
Foster Hill Road
Littleton, New Hampshire
October 18, 2013

nationalgrid

VHB Vanasse Hangen Brustlin, Inc.



FACING LITTLETON SUBSTATION
(APPROX. 0.2 MILES)

PROPOSED WIRE
CONDUCTOR: 795 ACSR "DRAKE"
SHIELDWIRE: (2) 3/8" EHS STEEL

Source:
NGRID T-SHEETS
VHB

C203 New 230 kV Tap Line

Figure 7 ROW Cross-Section
Littleton Substation
Foster Hill Road
Littleton, New Hampshire

October 18, 2013

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.

Appendix M

Gradient Report on EMF Levels

Electric and Magnetic Fields (EMF) Analysis for C203 New 230-kV Tap at Littleton Substation

Prepared for
National Grid
40 Sylvan Rd
Waltham, MA 02451

January 13, 2014

GRADIENT
www.gradientcorp.com
20 University Road
Cambridge, MA 02138
617-395-5000

Table of Contents

Page

List of Tables

List of Figures

1 Introduction and Summary

National Grid proposes to build a new 230-kV tap line off of the existing C203 transmission line to connect to Littleton Substation in Littleton, NH. At present, the C203 main line runs from Moore Substation in Littleton, NH to Comerford Substation in Monroe, NH adjacent to the National Grid D204 230-kV transmission line. The proposed tap line will share the right-of-way (ROW) adjacent to Littleton Substation with the existing D204 tap line, the Vermont Electric Power Company K60 - St. Johnsbury #29 115-kV transmission line (VELCO K60), and the Public Service of New Hampshire Q195 115-kV transmission line (PSNH Q195). The western side of the existing ROW will be expanded to accommodate the new tap line (National Grid, 2013a).

Gradient performed an independent assessment of the electric and magnetic fields (EMF) impact of the proposed tap line. We modeled pre-project and post-project EMF for the ROW between Littleton Substation and the C203 and D204 main lines at projected peak loads supplied by National Grid (National Grid, 2013b; Quigley, 2013a,b,c). We also assessed pre-project magnetic fields (MF) by collecting MF measurements around the substation perimeter and at two traverses in the adjacent ROW on September 10, 2013. As described in this report, we found that all EMF levels, both modeled and measured, fall well below the International Commission on Non-Ionizing Radiation Protection (ICNIRP) health-based guidelines for continuous public exposure to EMF (4.2 kV/m and 2,000 mG; ICNIRP, 2010).

We found that, at the western ROW edge, where the ROW edge is closest to the tap lines, the maximum modeled MF value approximately 3 feet above ground surface decreases from 10.2 mG in the pre-project model to 4.6 mG in the post-project model. The decrease in MF is due to: (1) an increase in distance between the ROW edge and the nearest transmission line, and (2) low post-project electric currents relative to pre-project levels. At the eastern ROW edge, where the ROW edge is closest to Lines Q195 and K60, MF does not change from its pre-project level of 1.3 mG. The maximum MF value within the ROW also does not change from its pre-project level (85.1 mG), and it occurs beneath the crossing of Lines K60 and C203, approximately 1,000 feet north of Littleton Substation.

We found that the maximum modeled electric field (EF) value at the western ROW edge decreases from 2.1 kV/m pre-project to 0.3 kV/m post-project due to an increase in the distance between the ROW edge and the nearest transmission line. At the eastern ROW edge, the EF does not change from its pre-project level of 0.02 kV/m. The maximum within-ROW EF value also does not change from its pre-project value which is 2.9 kV/m.

In this report, Section 2 describes the nature of EMF and provides values for EMF levels, both from common sources and from available EMF exposure guidelines. Section 3 measured present-day magnetic field levels. Section 4 outlines the EMF modeling procedures used for calculating electric and magnetic field strengths as a function of lateral distance from the lines and provides graphical and tabular results. Section 5 summarizes the conclusions, and Section 6 lists the bibliographic references.

2 Nature of Electric and Magnetic Fields

All matter contains electrically charged particles. Most objects are electrically neutral because positive and negative charges are present in equal numbers. When the balance of electric charges is altered, we experience electrical effects, such as the static electricity attraction between a comb and our hair, or drawing sparks after walking on a synthetic rug in the wintertime. Electrical effects occur both in nature and through use of electric power (generation, transmission, and consumption).

2.1 Definition of Electric and Magnetic Fields

The electrical tension on utility power lines is expressed in volts or kilovolts (kV; 1 kV = 1,000 V). Voltage can be thought of as the pressure driving the flow of electricity, and can be envisioned as analogous to the pressure of water in a plumbing system. The existence of a voltage difference between power lines and ground results in an electric field, usually expressed in units of kilovolts per meter (kV/m). The size of the electric field depends on the voltage, the separation between lines and ground, and other factors.

Power lines also carry an electric current that creates a magnetic field. The units for electric current are amperes (A) and are a measure of the flow of electricity. Electric current can be envisioned as analogous to the flow of water in a plumbing system. The magnetic field produced by an electric current is usually expressed in units of gauss (G) or milligauss (mG), where 1 G = 1,000 mG. Another unit for magnetic field levels is the microtesla (μT), where 1 μT = 10 mG. The size of the magnetic field depends on the electric current, the distance to the current-carrying conductor, and other factors.

2.2 Natural and Anthropogenic Sources of EMF

Everyone experiences a variety of natural and man-made electric and magnetic fields. Electric and magnetic field levels can be slowly varying or steady [often called direct current (DC) fields], or can vary in time [often called alternating current (AC) fields]. When the time variation of interest corresponds to that of power line currents, *i.e.*, 60 cycles per second, the fields are called 60 Hertz (Hz) EMF. Man-made magnetic fields are common in everyday life. For example, many childhood toys contain permanent magnets that generate strong, steady magnetic fields. Typical toy magnets (*e.g.*, refrigerator door magnets) have fields of 100,000 to 500,000 mG.

On a larger scale, the earth's core creates a steady magnetic field that can be easily demonstrated with a compass needle. The size of the earth's magnetic field in the northern US is about 550 mG (over a hundred times smaller than fields generated by "refrigerator door" magnets). Knowing the strength of the earth's magnetic field provides a perspective on the size of power line magnetic fields.

The earth's steady field does not have the 60-Hz time variation characteristic of power line EMF, but is experienced as a changing magnetic field as one moves around in it. Alternatively, moving magnets generate time-varying magnetic fields. For example, a magnet spinning at 60 times a second will produce a 60-Hz magnetic field indistinguishable from that found near electric power lines carrying the appropriate level of electric current. Even the rotating steel-belted radial tires on a car produce time-varying magnetic fields. And although magnetic resonance imaging (MRI) is a diagnostic procedure that

puts humans in much larger, but steady, magnetic fields (*e.g.*, 20,000,000 mG), it is preferred over taking an X-ray picture. Contrary to X-rays, MRIs have no known health risks (other than the large forces exerted on nearby steel objects).

2.3 EMF Near Power Lines and Appliances

Electric power transmission lines, distribution lines, and electric wiring in buildings carry AC currents and voltages that change size and direction at a frequency of 60 Hz. These 60-Hz currents and voltages create 60-Hz EMF nearby. The size of the magnetic field is proportional to the line current, and the size of the electric field is proportional to the line voltage. The EMF associated with electrical wires and electrical equipment decreases rapidly with increasing distance away from the electrical wires.

When EMF derives from different sources (*e.g.*, adjacent wires), the size of the net EMF produced will be somewhere in the range between the sum of EMF from the individual sources and the difference of the EMF from the individual sources. Thus, EMF may partially add or partially cancel, but generally, because adjacent wires of a circuit are often carrying current in opposite directions, the EMF produced tends to be cancelled. Inside residences, typical baseline 60-Hz magnetic fields (far away from appliances) range from 0.5 to 5.0 mG. EMF in the home arises from electric appliances, indoor wiring, grounding currents on pipes and ground wires, and outdoor distribution or transmission circuits. All these separate power-line magnetic fields add or subtract from the steady field of the earth (450-550 mG in the mid-latitudes) so that the sum total magnetic field in the home has both a steady part and a time-varying part (NOAA, 2013).

Higher 60-Hz magnetic field levels are found near operating appliances. For example, can openers, mixers, blenders, refrigerators, fluorescent lamps, electric ranges, clothes washers, toasters, portable heaters, vacuum cleaners, electric tools, and many other appliances generate magnetic fields of size 40 to 300 mG at distances of 1 foot (NIEHS, 2002). Magnetic fields from personal care appliances held within ½ foot (*e.g.*, shavers, hair dryers, massagers) can produce 600 to 700 mG. At school and in the workplace, lights, motors, copy machines, vending machines, video-display terminals, pencil sharpeners, electric tools, and electric heaters are all sources of 60-Hz magnetic fields.

2.4 State, National, and International Guidelines for EMF

The US has no federal standards limiting occupational or residential exposure to 60-Hz EMF. Table 2.1 shows guidelines suggested by national and world health organizations. The levels shown on Table 2.1 are designed to be protective against any adverse health effects. The limit values should not be viewed as demarcation lines between safe and dangerous levels of EMF, but rather, levels that assure safety with an adequate margin of safety to allow for uncertainties in the science. Table 2.2 lists guidelines that have been adopted by various states in the US. State guidelines are not health-effect based and have been typically adopted to maintain the *status quo* for EMF on and near transmission line ROWs.

Table 2.1 60-Hz EMF Guidelines Established by Health and Safety Organizations

Organization	Magnetic Field (mG)	Electric Field (kV/m)
American Conference of Governmental and Industrial Hygienists (ACGIH)	10,000[a]	25[a]
(occupational)	1,000[b]	1[b]
International Commission on Non-Ionizing Radiation Protection (ICNIRP) (general public, continuous exposure)	2,000	4.2
Non-Ionizing Radiation (NIR) Committee of the American Industrial Hygiene Assoc. (AIHA) endorsed (in 2003) ICNIRP's occupational EMF levels for workers	4,170	8.3
Institute of Electrical and Electronics Engineers (IEEE) Standard C95.6 (general public, continuous exposure)	9,040	5.0
UK, National Radiological Protection Board (NRPB) [now Health Protection Agency (HPA)]	2,000	4.2
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Draft Standard, Dec. 2006[c]	3,000	4.2
Comparison to steady [see text] *(DC) EMF, encountered as EMF outside the 60-Hz frequency range:*		
Earth's magnetic field and atmospheric electric fields, steady levels, typical of environmental exposure[d]	520[e]	0.2 up to > 12
Magnetic Resonance Imaging Scan, static magnetic field intensity[d]	20,000,000	–

Notes:
(a) The ACGIH (2010a) guidelines for the general worker (ACGIH, 2010b, p124-127).
(b) The ACGIH (2010a) guideline for workers with cardiac pacemakers (ACGIH, 2010b, p124-127).
(c) ARPANSA (2006, 2008).
(d) These EMF are steady fields and do not vary in time at the characteristic 60 cycles-per-second that power-line fields do. However, if a person moves in the presence of these fields, the body experiences a time-varying field.
(e) At 42 degrees latitude (NOAA, 2013).

Table 2.2 State EMF Standards and Guidelines for Transmission Lines

State/Line Voltage	Electric Field (kV/m)		Magnetic Field (mG)	
	On ROW	Edge ROW	On ROW	Edge ROW
69 – 230 kV	8.0	2.0[b]		150
Florida				
500 kV	10.0			200, 250[c]
Massachusetts		1.8		85
Minnesota	8.0			
Montana	7.0[d]	1.0[e]		
New Jersey		3.0		
New York[a]	11.8	1.6		200
	11.0[f]			
	7.0[d]			
Oregon	9.0			

Notes:
ROW = right of way; mG = milligauss; kV/m = kilovolts per meter.
Sources: NIEHS (2002); FDEP (2008).
(a) Magnetic fields for winter-normal, *i.e.*, at maximum current-carrying capability of the conductors.
(b) Includes the property boundary of a substation.
(c) 500 kV double-circuit lines built on existing ROWs.
(d) Maximum for highway crossings.
(e) May be waived by the landowner.
(f) Maximum for private road crossings.

3 Magnetic Field Measurements

3.1 Procedures for Measuring Magnetic Fields

Gradient measured present-day magnetic field (MF) strengths near the Littleton Substation on September 10, 2013, between approximately 1:30 and 2:30 PM. Conditions were humid following a steady rain, with an overcast sky and temperatures near 60 ºF. We recorded MF measurements along three traverses: (A) around the perimeter of Littleton Substation, (B) across the ROW beneath the D204 tap line, VELCO K60, and PSNH Q195, and (C) across the ROW beneath the C203 and D204 main lines near the D204 tap line connection. Figure 3.1 shows the locations of each traverse relative to Littleton Substation.

The measurement traverses were selected to be consistent with the Institute of Electrical and Electronics Engineers (IEEE) guidelines (1995a). To the degree possible, the traverses across the ROW were picked to be close to mid-span so as to be near the maximum line sag, at which point the lines are generally running parallel with and nearest to the ground. Because of the uneven grade in Traverses B and C, the elevation of the measurement point relative to the lowest conductor likely changed by +/-2 feet over the course of the traverses in the ROW. These changes in vertical increment likely caused fluctuations in the measured MF level by no more than +/- 10%.

MF levels were recorded along the three above-mentioned traversals using an EMDEX II recording meter (manufactured by Enertech Consultants, Campbell, CA). Specifications for this instrument appear in Table 3.1.

Table 3.1 Specifications for the EMDEX II Meter

Attribute	Description
Sensors	Three orthogonally oriented magnetic field sensor coils.
Sensitivity	Magnetic fields: 0.1-3,000 mG. Reports magnetic field resultant [root mean square (RMS)] in the broad band mode, the frequency bandwidth being 40 Hz to 800 Hz.
Features	Automatic multi-range measurement capability. Output can be selected between "Survey" and "Normal" measurement modes.
Amplitude Response	True RMS measurement with a "Crest Factor" of a periodic signal.
Power	One 9-volt alkaline battery.
Output	Survey mode: display data values on LCD. Normal mode: sampled data stored in memory.

The EMDEX II reports the resultant field strength in mG.[1] This meter satisfies the IEEE instrumentation standards for measuring MF strength at power line frequencies (IEEE, 1995a,b). The device records these measurements either every 1.5 or 3 seconds and allows the user to designate "events" corresponding to measurements at specific locations. We estimated distances using known distances between recorded "events" and assuming constant speed during measurement collection. For each traversal, we measured MF strength every 1.5 seconds at an elevation of approximately 3 feet above grade.

[1] The resultant field strength (B_r) is equal to the square root of the sum of the squared field intensity values measured along three orthogonal axes. That is, $B_r = \sqrt{B_x^2 + B_y^2 + B_z^2}$, where B_x, B_y, and B_z are the field intensity measurements along the *x*, *y*, and *z* axes.

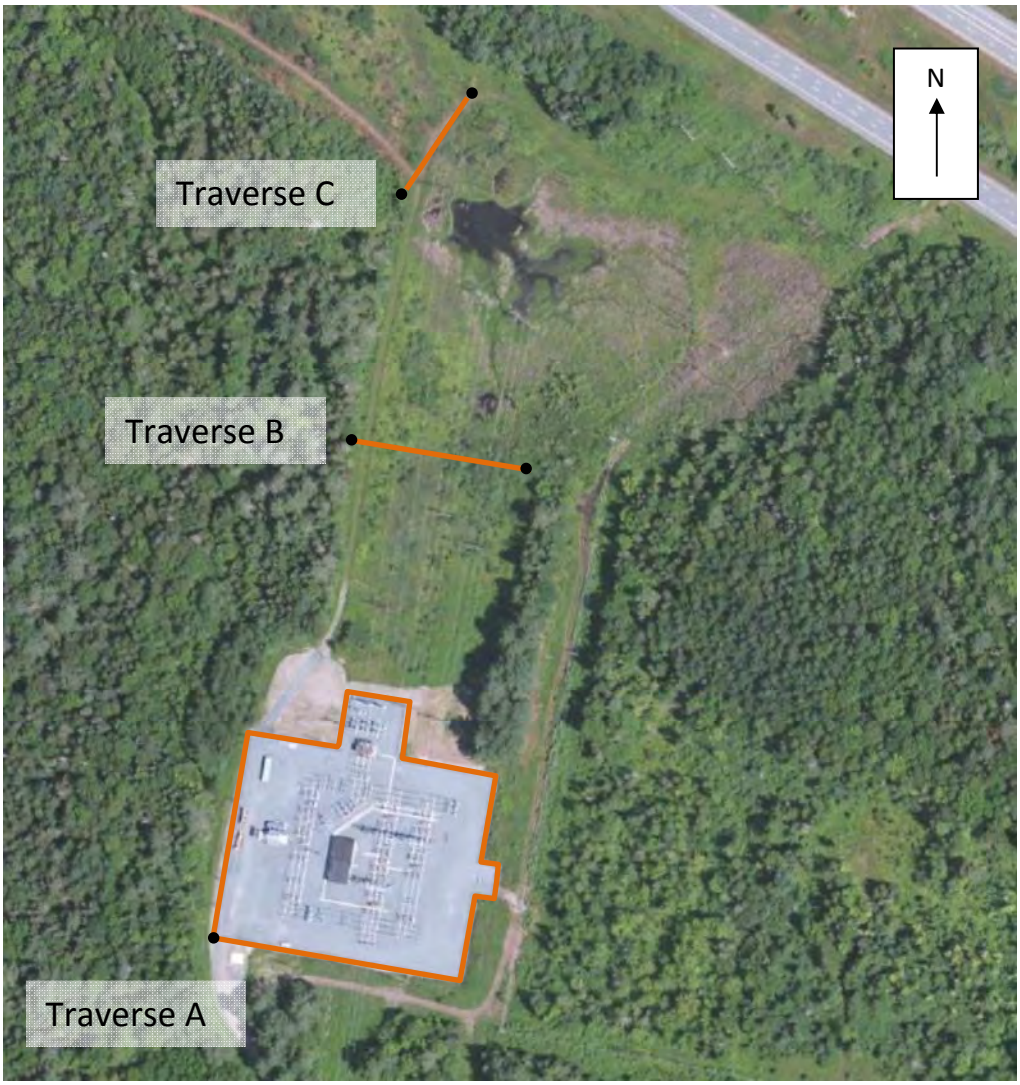


Figure 3.1 Map of Magnetic Field Measurement Traverses Near Littleton Substation in Littleton, NH. The approximate traverse paths are shown in orange and the traverse end points are shown as black dots. Measurements were collected clockwise around Littleton Substation and were collected twice for Traverses B and C, once in each direction.

3.2 Power-Line Loads on Circuit Phase Conductors

Due to the time of day (2 PM) and ambient temperature (60 °F), load flows at the time of measurement were low relative to the peak load values used for EMF modeling. The estimated loads at approximately 2 PM on September 10, 2013 are summarized in Table 3.2 (Quigley, 2013a,b,d).

Table 3.2 Voltage and Electric Current Magnitude and Direction for Transmission Lines Near Littleton Substation on September 10, 2013 at 2 PM

Transmission Line	Voltage (kV)	Current (A)	Direction of Current
C203 Main Line	230	6	Moore to Comerford
D204 Main Line	230	118	Moore to Comerford
D204 Tap Line	230	60	Into Littleton Substation
VELCO K60	115	77	Out of Littleton Substation
PSNH Q195	115	18	Into Littleton Substation

3.3 Measurement Results

The magnetic field strength profile as a function of distance for Traverses A, B, and C are shown in Figures 3.2, 3.3, and 3.4, respectively. Vertical lines indicate the approximate positions of the substation corners (Figure 3.2) and transmission line center conductors (Figures 3.3 and 3.4). The maximum measured MF levels are summarized in Table 3.3 below.

Table 3.3 Maximum Magnetic Field per Traverse Measured on September 10, 2013 at 2 PM

Traverse	Maximum Magnetic Field (mG)	Location of Maximum Magnetic Field Level
A	9.3	Beneath D204 Tap Line
B	12.6	Beneath VELCO K60
C	14.1	Beneath C203

Figure 3.2 shows the MF measurements around the perimeter of the substation peak at 9.2 mG between the northwestern and northeastern corners of the substation fence perimeter. This highest MF level occurs beneath the D204 tap-line while a secondary peak occurs beneath VELCO K60. While electric current on VELCO K60 at the time of measurement was higher than on the D204 tap line (77 A *vs*. 60 A), the K60 conductors are higher in elevation than the D204 tap line conductors at the substation perimeter (~40 ft. *vs*. ~30 ft.) resulting in slightly lower MF values directly underneath VELCO K60.

Figure 3.3 shows that the MF measurements along Traverse B peak at 12.6 mG beneath the VELCO K60 conductors and plateau at 6 mG beneath the D204 Tap Line. At the western ROW edge, located 35 feet west of the D204 tap line center conductor, the MF level is 4.6 mG.

Along Traverse C, shown in Figure 3.4, the MF levels peak underneath the D204 main line at 14.1 mG. Because of the low electric current on the C203 main line relative to the D204 main line at the time of measurement (6 A *vs*. 118 A), the MF from the D204 main line dominate the MF profile.

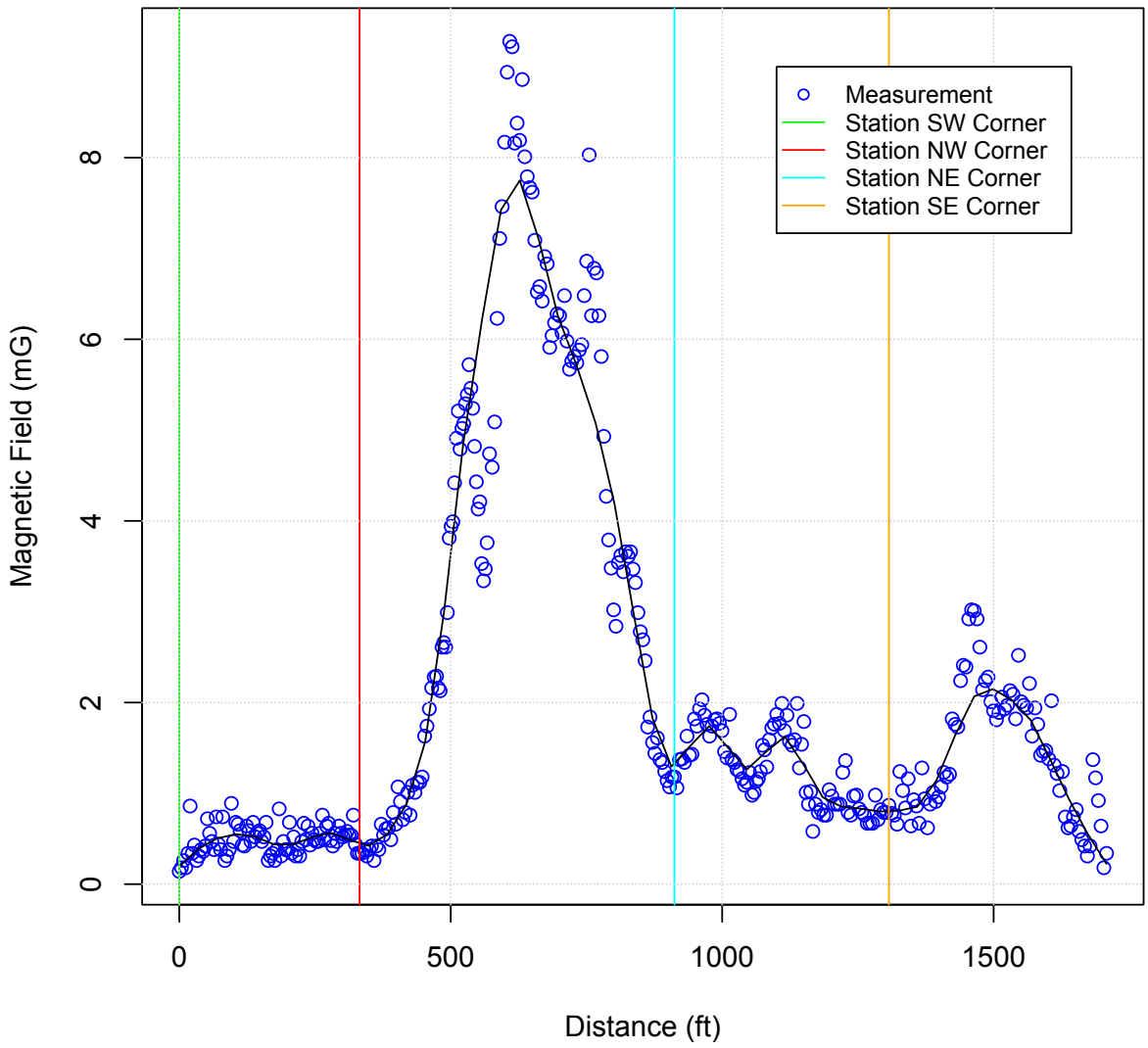


Figure 3.2 Plot of Magnetic Field Strength as a Function of Distance in Feet Walked Clockwise along the Perimeter of the Littleton Substation Starting at the Southwestern Corner of the Fence-line (Traverse A). All measurements were collected outside of the perimeter fence approximately 3 feet above ground surface. The maximum MF level is 9.3 mG and occurred near the D204 Tap Line (x = 600). MF levels greater than 6 mG also occurred beneath VELCO Line K60 (x = 660 to x = 700).

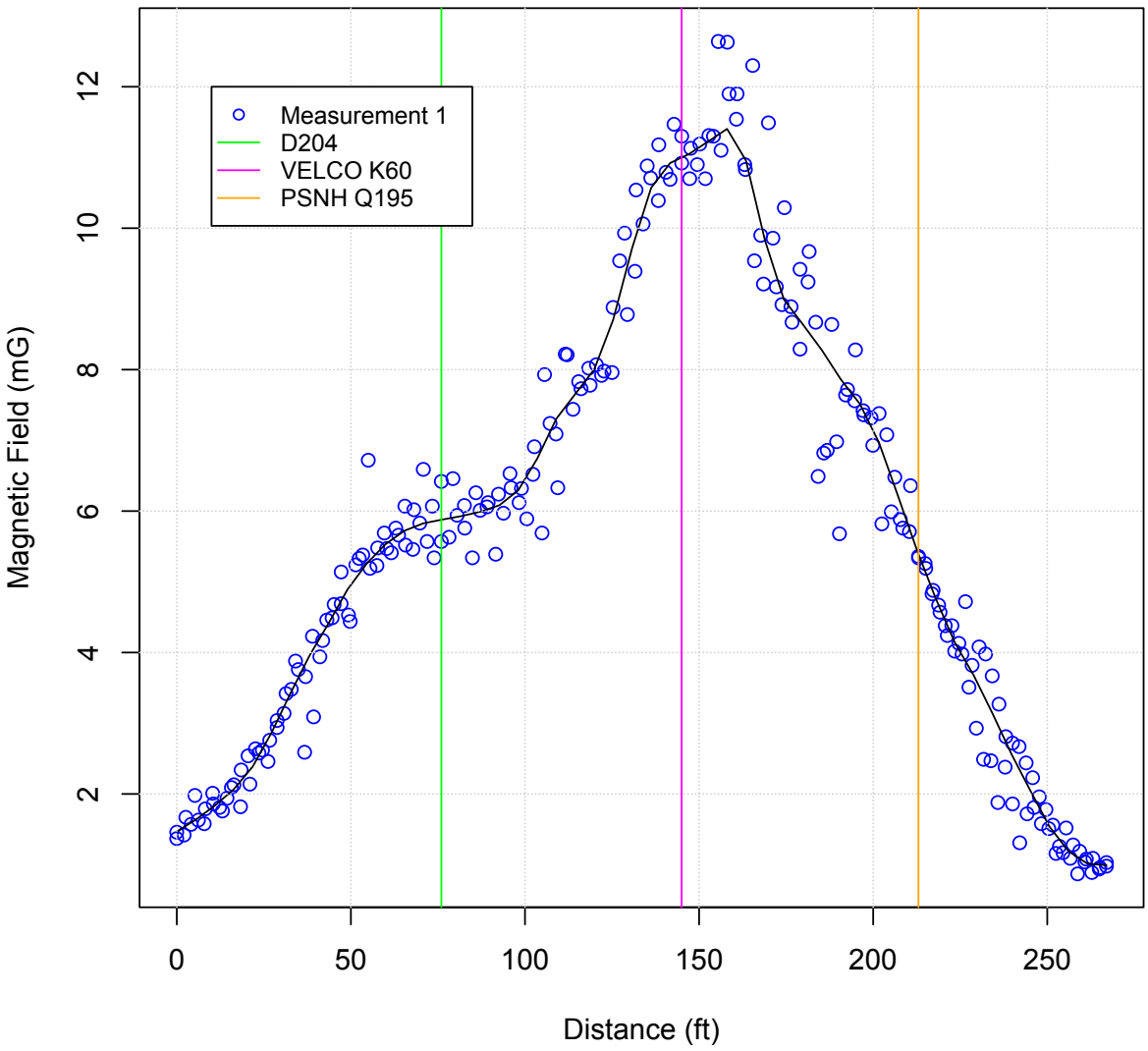


Figure 3.3 Plot of Magnetic Field Strength as a Function of Distance in Feet for Traverse B from West to East. All measurements were collected approximately 3 feet above ground surface. The western ROW edge is located at approximate coordinate *x* = 40, a distance of 35 feet west of the D204 tap line center conductor (green vertical line). The MF level at the western ROW edge is 4.7 mG and the maximum MF level measured is 12.6 mG, located beneath VELCO Line K60 (magenta vertical line).

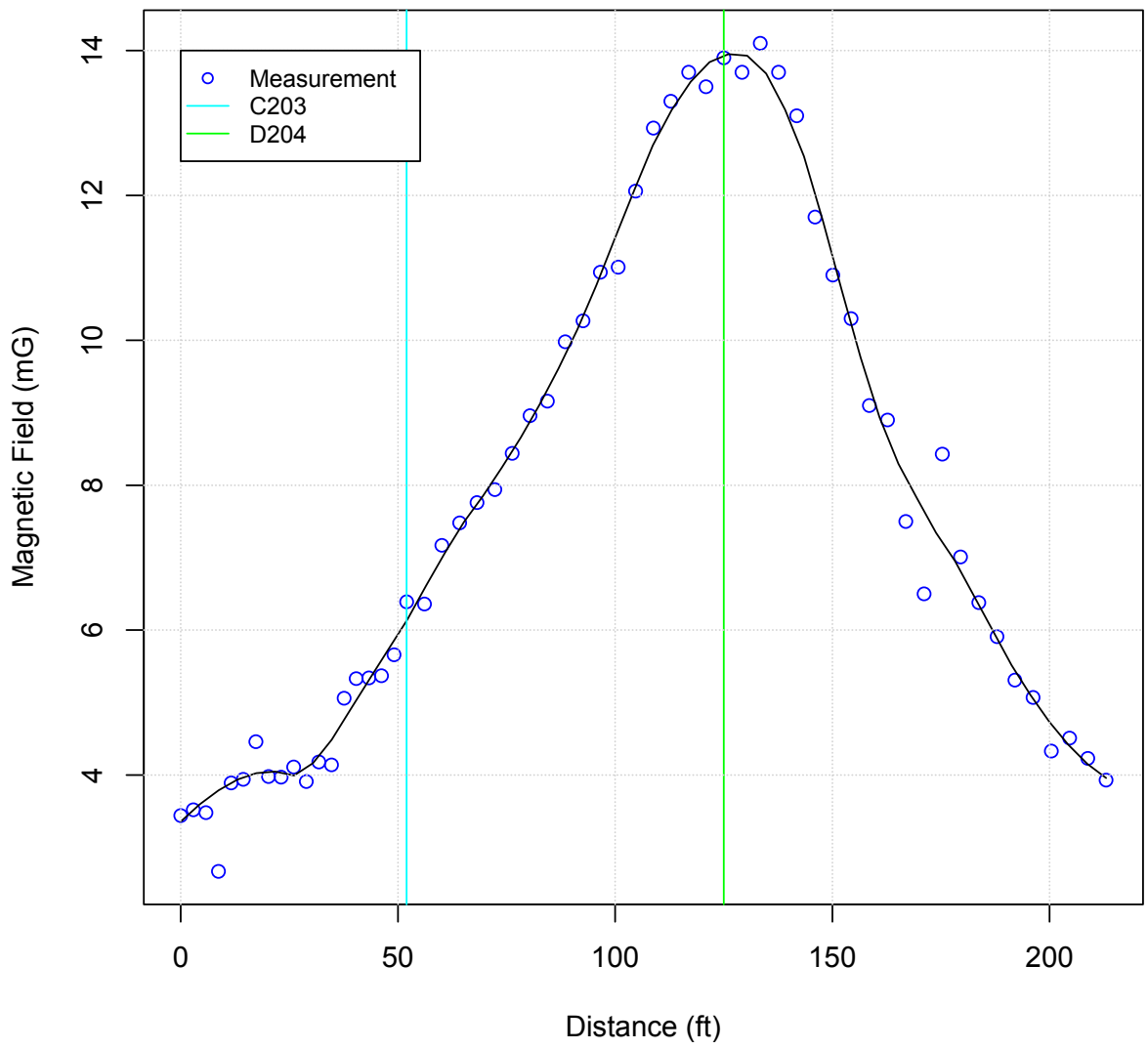


Figure 3.4 Plot of Magnetic Field Strength as a Function of Distance in Feet for Traverse C from South to North. All measurements were collected approximately 3 feet above ground surface. The maximum MF level is 14.1 mG, located beneath the D204 main line (green vertical line).

4 EMF Modeling

4.1 Software Programs Used for Modeling EMF

We used the SUBCALC module of the EMF WorkStation[2] software, designed by the Electric Power Research Institute (EPRI), to model the magnetic field strengths as a function of current and distance from aboveground transmission lines near Littleton Substation. We used the FIELDS computer program, designed by Southern California Edison, to calculate magnetic and electric field strengths from the transmission lines at a cross-section perpendicular to the lines as a function of voltage, current, and distance. Both of these programs operate using Maxwell's equations, which accurately describe the laws of physics as they apply to electricity and magnetism. Modeled fields using these programs are both precise and accurate for the input data utilized. Results of both models have been checked extensively against each other and against other software (*e.g.*, "CORONA" from the Bonneville Power Administration, US Dept. of Energy) to ensure that the implementation of the laws of physics are consistent. In these validation tests, program results for EMF were found to be in very good agreement with each other.

4.2 Power-Line Loads

Magnetic fields produced by the existing and proposed lines were modeled using line loadings communicated by National Grid. The current per phase satisfies the relationship:

(Eq. 4.1) $$S = \sqrt{3} \times V \times I_{phase}$$

where:

S	=	the apparent power in kilovolt-amps (kVA)
V	=	the line voltage in kilovolts (kV)
I_{phase}	=	the current per phase in amperes (A)

Thus, the current per phase conductor is:

(Eq. 4.2) $$I_{phase} = \frac{S}{\sqrt{3} \times V}$$

The pre-project and post-project electric current information per transmission line used for modeling EMF are summarized in Table 3.1 (Quigley, 2013a,b,c; National Grid, 2013b). Because the project is restricted to National Grid transmission lines, the pre-project and post-project loads on the VELCO K60 and PSNH Q195 transmission lines are assumed constant (Quigley, 2013b). EMF contributions from nearby distribution lines are negligible due to their large distance from the proposed C203 tap line and therefore were not included in the modeling.

[2] http://www.enertech.net/emfw/emfw.html; Enertech Consultants, 300 Orchard City Drive, Campbell, CA 95008.

Table 4.1 Voltage and Electric Current Magnitude and Direction for Transmission Lines Near Littleton Substation

Transmission Line	Voltage (kV)	Pre-Project Electric Current (A)	Post-Project Electric Current (A)	Pre-Project and Post-Project Direction of Current
C203 Tap Line	230	NA	35	Into Littleton Substation
C203 Main Line (Moore – Littleton)	230	171	171	Moore to Comerford
C203 Main Line (Littleton – Comerford)	230	171	157	Moore to Comerford
D204 Tap Line	230	66	36	Into Littleton Substation
D204 Main Line(Moore – Littleton)	230	200	198	Moore to Comerford
D204 Main Line(Littleton – Comerford)	230	173	183	Moore to Comerford
VELCO K60 – St. Johnsbury #29	115	322	322	Out of Littleton Substation
PSNH Q195	115	162	162	Into Littleton Substation

4.3 Power Line Configurations

The pre-project power lines connected to Littleton Substation consist of three transmission lines: 115-kV line K60 operated by VELCO, 115-kV line Q195 operated by PSNH, and 230-kV D204 tap line operated by National Grid (see Appendix A; National Grid, 2013a). All lines enter/exit to the 360-foot ROW adjacent to the northern side of the substation (WSP, 2013a). The D204 tap line center conductor is located approximately 35 feet horizontally from the western ROW edge and connects to 230-kV transmission line D204 approximately 1,000 feet north of Littleton Substation (WSP, 2013a). Line D204 is parallel to 230-kV transmission line C203 and both run east to west between Moore and Comerford Substations. VELCO K60 and PSNH Q195 run parallel to the D204 tap line near Littleton Substation and then parallel to the D204 and C203 main lines between Littleton and Moore.

The post-project configuration is the same as the pre-project configuration with one additional transmission line: a 230-kV C203 tap line connecting Littleton Substation to the C203 main line (see Appendix B; National Grid, 2013a). The tap line will be parallel to the existing D204 tap line, approximately 125 feet to the west. The ROW adjacent to Littleton Substation will be expanded on the western side to a width of approximately 550 feet (WSP, 2013b). The C203 tap line center conductor will be approximately 100 feet east of the post-project western ROW edge.

4.4 Magnetic Field Modeling Results

The top-down view magnetic field contour map for the pre-project and post-project configurations near Littleton Substation are shown in Figures 4.1 and 4.2, respectively. Transmission lines are shown as orange lines, and the boundaries for the substation and ROW edges are shown as black lines. All field values are for approximately 3 feet above ground surface. The modeling does not include circuitry within the substation and therefore the MF levels shown include only current sources outside of the station. Because phase conductors within the substation are closely spaced relative to each other, and their fields cancel quite effectively, their contribution to EMF levels outside the substation will be small.

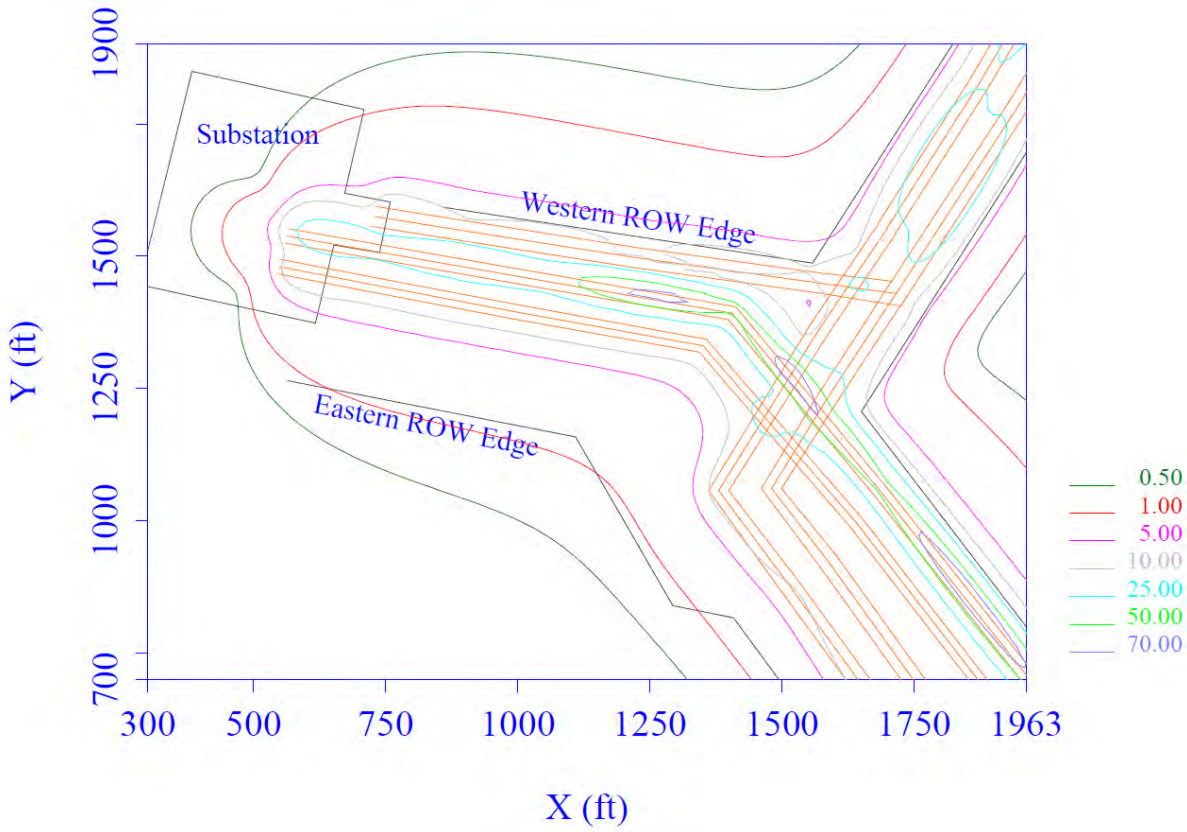


Figure 4.1 Top-view of Pre-Project Magnetic Fields North of Littleton Substation Approximately 3 Feet Above Grade. The top of the diagram is to the west. Orange lines represent power lines and black lines represent the fence-line of the substation and the ROW. The largest magnetic field value is 85.1 mG, located at approximate coordinates *x* = 1,500 and *y* = 1,250, where Line K60 crosses the C203 main line. The largest magnetic field value at the western edge of the ROW is 10.2 mG, located near the D204 tap at approximate coordinates *x* = 1,400 and *y* = 1,550. The largest magnetic field value at the eastern edge of the ROW is 1.3 mG, located at approximate coordinates *x* = 1,125 and *y* = 1,200.

The largest pre-project and post-project magnetic fields are localized directly underneath the VELCO K60 transmission line because of its high electric current relative to the other transmission lines and its relatively low height above ground. The MF intensity decreases rapidly with increasing distance away from the wires in both models. The maximum MF levels at the western ROW edge decreases from approximately 10 mG pre-project to 4.6 mG post-project. Within the ROW, the maximum magnetic field value is 85.1 mG for both models and occurs at the location where VELCO K60 crosses the C203 main line. All MF values fall below the ICNIRP health-based guideline of 2000 mG for MF (ICNIRP, 2010).

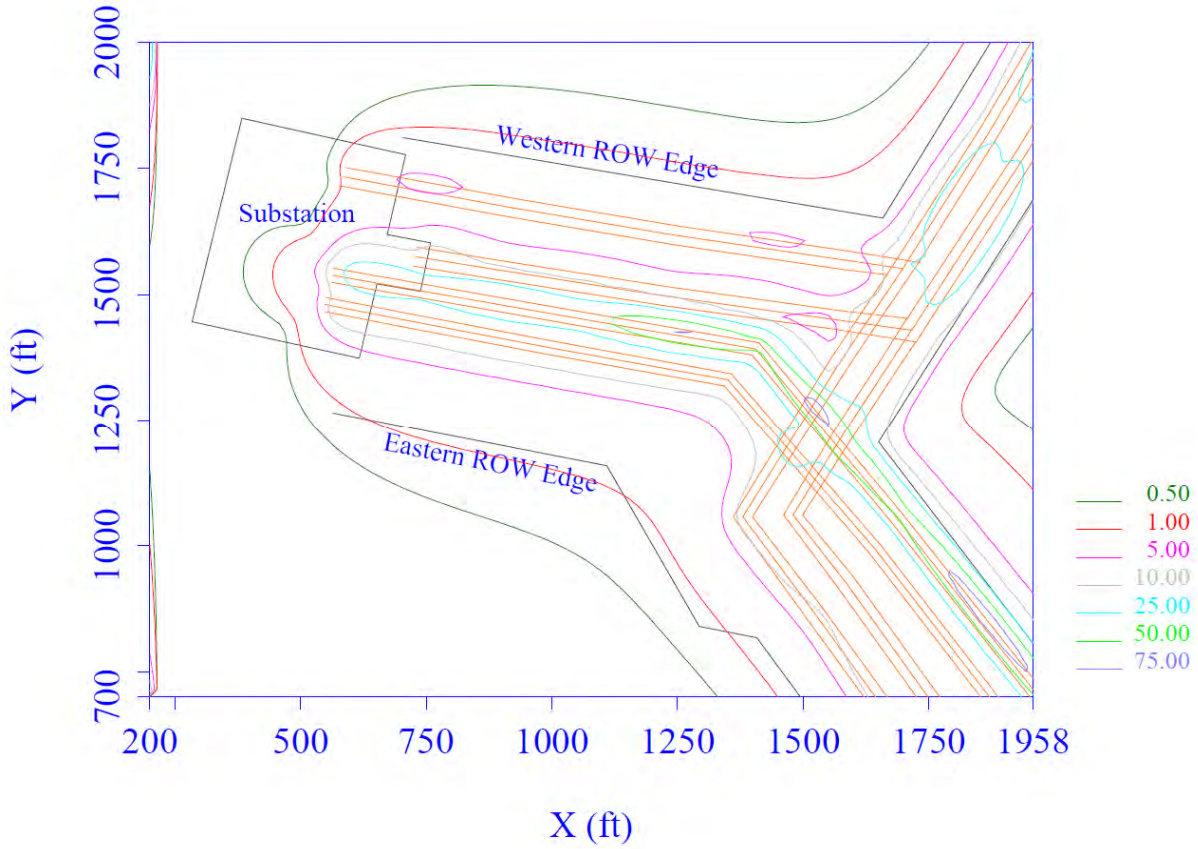


Figure 4.2 Top-view of Post-Project Magnetic Fields North of Littleton Substation at Approximately 3 Feet Above Grade. The top of the diagram is to the west. Orange lines represent power lines and black lines represent the fence-line of the substation and the ROW. The largest magnetic field value is 85.1 mG (same as pre-project), located at approximate coordinates *x* = 1,500 and *y* = 1,250, where Line K60 crosses the C203 main line. The largest magnetic field value at the western edge of the ROW is 4.6 mG, located near where the C203 tap line connects with the C203 main line, at approximate coordinates *x* = 1,700 and *y* = 1,700. The largest magnetic field value at the eastern edge of the ROW is 1.3 mG (same as pre-project), located at approximate coordinates *x* = 1,125 and *y* = 1,200.

Figure 4.3 provides cross-sectional graphical results of the pre-project and post-project magnetic field levels at approximately 3 feet above ground surface where the transmission lines are at maximum sag height. The view is north (away from the station) and perpendicular to the direction of current. The x-axis spans the entire ROW, a distance of 360 feet pre-project and 550 feet post-project.

As shown in the figure, the pre-project and post-project MF levels are the same except near the western ROW edge. This is because the configuration and loads on transmission lines VELCO K60 and PSNH Q195 are not impacted by the project. The MF level at the western ROW edge decreases from 10.2 mG pre-project to 1.4 mG post-project. This decrease is due to (1) an increase in the horizontal distance between the ROW edge and the nearest transmission line, from 35 feet pre-project to 100 feet between the post-project, and (2) a decrease in the electric current of the transmission line nearest the western ROW edge.

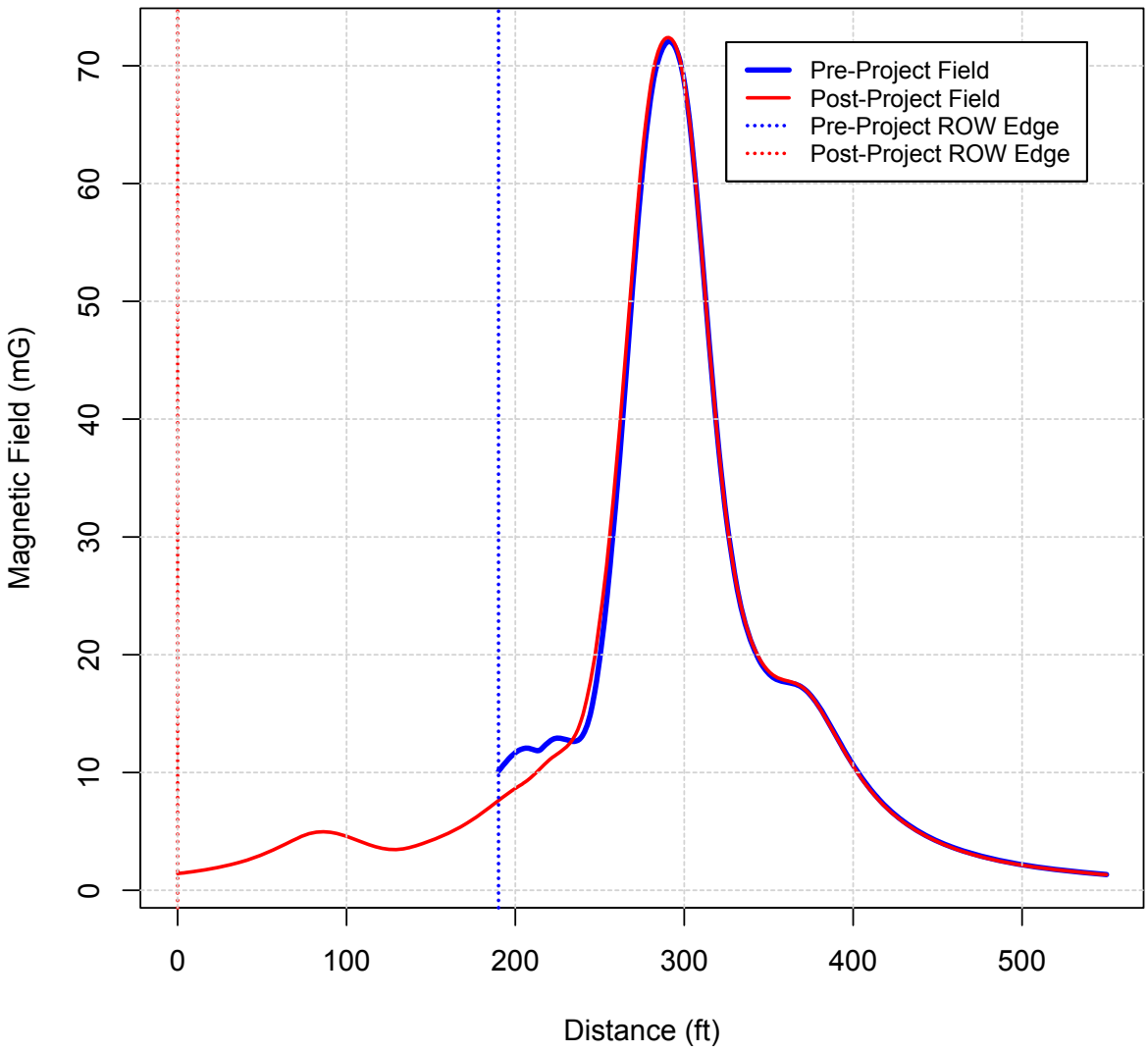


Figure 4.3 ROW Cross-section Magnetic Field Values Approximately 700 Feet North of Littleton Substation. The view is to the north, with the ROW cross-section being shown perpendicular to the D204 and C203 tap lines. Local maximum in MF levels occur below Transmission Lines C203 Tap (x = 100), D204 Tap (x = 225), K60 (x = 295), and Q195 (x = 365). At the western ROW edge (x = 190 pre-project and x = 0 post-project), the MF decreases, from 10.2 mG to 1.4 mG. At the eastern ROW edge (x = 575), the MF level is 1.3 mG for both pre-project and post-project. Within the ROW, the maximum MF level is 85.1 mG, located beneath Line K60.

4.5 Electric Field Modeling Results

Figure 4.4 below provides cross-sectional graphical results of the calculated electric field (EF) for the same cross-section shown in Figure 4.3. EF levels shown are approximately 3 feet above ground surface.

Because the spatial layout and voltages of the D204 tap line, VELCO K60, and PSNH Q195 do not change between the two models, the pre-project and post-project electric fields near these lines are approximately the same. EF levels decreased from 2.2 kV/m at the pre-project western ROW edge to 0.3 kV/m at the post-project ROW edge due to the increase in distance between the ROW edge and the

nearest transmission line. The maximum EF value within the ROW is 2.9 kV/m, located between D204 and VELCO K60. All EF values fall below the ICNIRP health-based guideline of 4.2 kV/m for EF (ICNIRP, 2010).

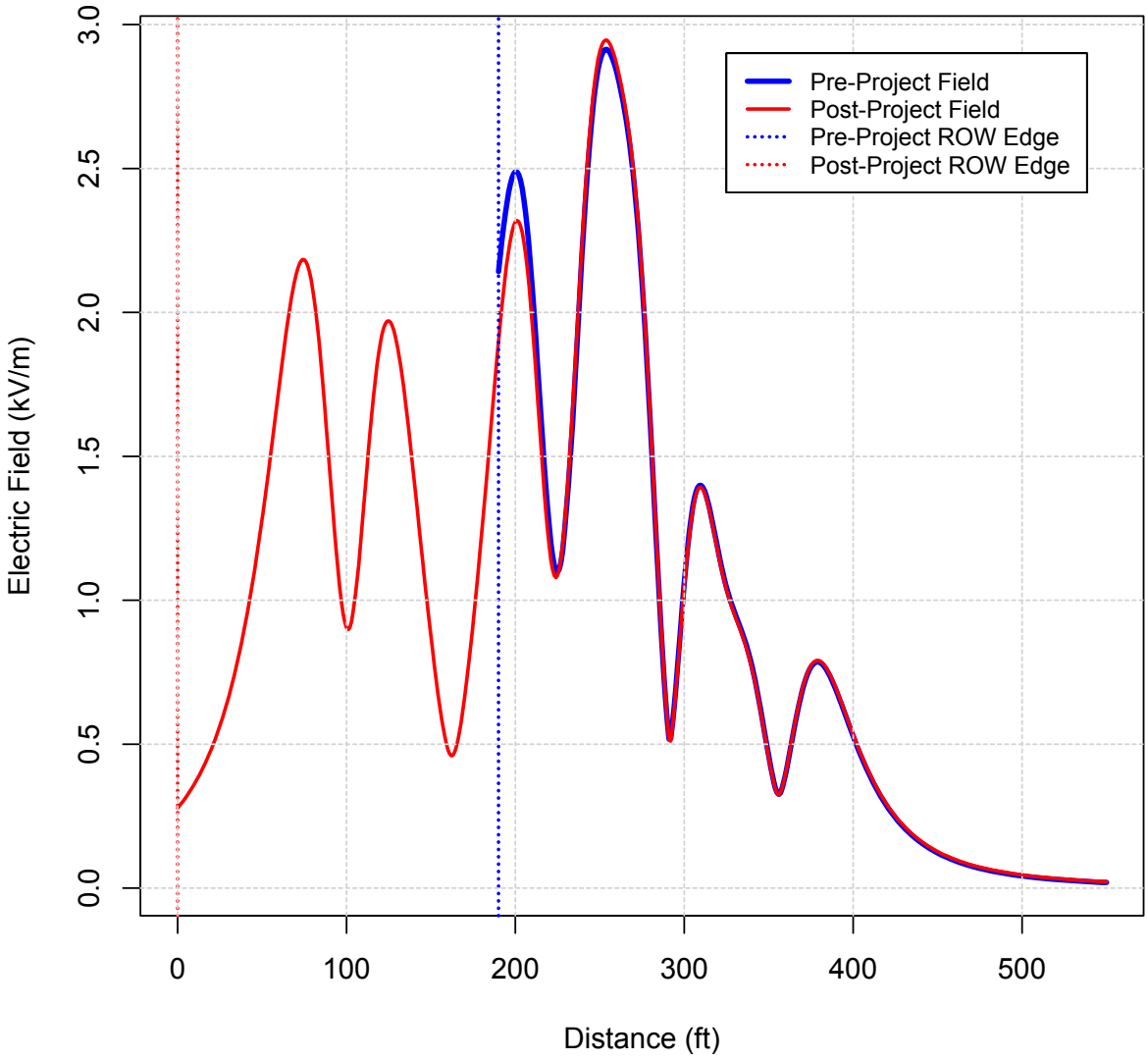


Figure 4.4 ROW Cross-section Electric Field Values Approximately 700 Feet North of Littleton Substation. The view is to the north, with the ROW cross-section being shown perpendicular to the transmission line conductors. At the western ROW edge the EF level decreases from 2.2 kV/m pre-project (x = 190) to 0.3 kV/m post-project (x = 0). At the eastern ROW edge (x = 575), the EF level is 0.02 kV/m for both pre-project and post-project. Within the ROW, the maximum EF level is 2.9 kV/m, located between D204 Tap Line (x = 225) and VELCO K60 (x = 290).

5 Conclusions

Gradient modeled the EMF levels near Littleton Substation at approximately 3 feet above ground before and after construction of the proposed C203 tap line. Table 5.1 summarizes the EMF modeling results.

Table 5.1 Modeled Maximum Pre-Project and Post-Project Electric and Magnetic Fields Approximately 3 Feet Above Ground Surface

Model Location	Maximum Magnetic Field (mG)		Maximum Electric Field (kV/m)	
	Pre-Project	Post-Project	Pre-Project	Post-Project
Western Edge-of-ROW	10.2	4.6	2.2	0.3
Eastern Edge-of-ROW	1.3	1.3	0.02	0.02
Within-ROW	85.1	85.1	2.9	2.9

Both EF and MF levels decrease at the western ROW edge from pre-project to post-project. This decrease is due to the increase in distance between the ROW edge and the nearest transmission line center conductor, from 35 feet pre-project to 100 feet post-project, and a decrease in the electric current on the transmission line nearest the western ROW edge. EMF at the eastern ROW edge does not change because the transmission lines nearest the ROW edge, VELCO K60 and PSNH Q195, are unaffected by the project.

For comparison, Gradient also collected present-day MF measurements around Littleton Substation and across two ROW transects near the substation. Table 5.2 summarizes the MF measurement results.

Table 5.2 Magnetic Fields Approximately 3 Feet Above Ground Surface Measured on September 10, 2013 at 2 PM

Model Location	Maximum Magnetic Field (mG)
Western Edge-of-ROW	4.7
Within-ROW	14.1
Littleton Substation Perimeter	9.3

All measured magnetic field values are lower than modeled pre-project values because of low energy demand, and consequently low power loads, at the time of measurement collection. While our modeled EMF values were calculated at annual peak load, our measurements reflect levels under normal load for mid-day in late summer.

Overall, all measured and modeled EMF levels fall below the ICNIRP 60-Hz EMF safety guideline values of 2,000 mG for magnetic fields and 4.2 kV/m (ICNIRP, 2010). Therefore, there is no expectation of adverse health effects due to the EMF levels from the proposed project.

References

American Conference of Governmental Industrial Hygienists (ACGIH). 2010a. "2010 Guide to Occupational Exposure Values." ACGIH Publication No. 0388. 240 p.

American Conference of Governmental Industrial Hygienists (ACGIH). 2010b. "2010 TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices." ACGIH Publication No. 0110. 254p.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). 2006. "Radiation Protection Standard; Exposure Limits for Electric & Magnetic Fields – 0 Hz to 3 kHz (Public consultation draft)." 163p., December 7.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). 2008. "Forum on the Development of the ELF Standard." 1p., June 12.

Florida Dept. of Environmental Protection (FDEP). 2008. "Electric and Magnetic Fields." FAC 62-814. Accessed at http://www.dep.state.fl.us/siting/files/rules_statutes/62_814_emf.pdf, 13p., June 1.

IEEE Power Engineering Society (IEEE). 1995a. "IEEE Standard Procedures for Measurement of Power Frequency, Electric and Magnetic Fields from AC Power Lines." Institute of Electrical and Electronics Engineers, Inc., New York. IEEE Std. 644-1994, March 7.

IEEE Power Engineering Society. (IEEE). 1995b. "IEEE Recommended Practice for Instrumentation: Specifications for Magnetic Flux Density and Electric Field Strength Meters - 10 Hz to 3 kHz." Institute of Electrical and Electronics Engineers, Inc., New York, NY. IEEE Std. 1308-1994. 40p., April 25.

International Commission for Non-Ionizing Radiation Protection (ICNIRP). 2010. "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (1 Hz to 100 kHz)." *Health Physics* 99(6):818-836.

National Grid. 2013a. "Technical Scope Document: C203 New 230kV Tap at Littleton Substation." 46p., August 5.

National Grid. 2013b. "St. Johnsbury K60 Measured Load Values." 1p., September 4.

National Institute of Environmental Health Sciences (NIEHS). 2002. "Questions and Answers about EMF Electric and Magnetic Fields Associated with the Use of Electric Power." 65p., June.

National Oceanic and Atmospheric Administration (NOAA). 2013. "Magnetic Field Calculators: Estimated Values of Magnetic Field." National Geophysical Data Center. Accessed at http://www.ngdc.noaa.gov/geomag-web/?id=igrfwmmFormId#igrfwmm.

Quigley, PJ. [National Grid]. 2013a. Email to E. Lundgren (Gradient) re: C203 project. 3p., October 8.

Quigley, PJ. [National Grid]. 2013b. Email to E. Lundgren (Gradient) re: Meeting today. 3p., October 21.

Quigley, PJ. [National Grid]. 2013c. Email correspondence to E. Lundgren (Gradient) re: C203/D204 data for EMF. 3p., September 6.

Quigley, PJ. [National Grid]. 2013d. Email correspondence to E. Lundgren (Gradient) [re: EMF Study - Littleton NH (VC203 and D204 circuits)]. 5p., September 12.

WSP Transportation & Infrastructure (WSP). 2013a. "Existing Conditions Survey, Littleton Substation, Foster Hill Road, Littleton, New Hampshire." Report to National Grid (Waltham, MA), Drawing 093023-048-1.dwg. 1p., October 25.

WSP Transportation & Infrastructure (WSP). 2013b. "Exhibit Plan of Land, Littleton Substation, Foster Hill Road, Littleton, New Hampshire." Report to National Grid (Waltham, MA), Drawing 093023-048-EXHIBIT. 1p., October 31.

Appendix A

Pre-Project Power Line Configuration Near Littleton Substation

N/F WOJTUL PETER
Map 41 Lot 6

N/F NEW HAMPSHIRE STATE OF
Map 41 Lot 1

N/F TRANSCANADA HYDRO NORTHEAST INC
Map 41 Lot 7

N/F PUBLIC SERVICE CO OF N.H.
Map 41 Lot 8

N/F WOJTUL PETER
Map 41 Lot 9

Littleton Substaton

N/F WINN, GREGORY H.
Map 41 Lot 10

D 204 Tap Line

PSNH Q195 Lines

3315 34.5 KV Littleton Municipal Line

C203 Line

D204 Line

I-93 Southbound

I-93 Northbound

St. Johnsbury #29 Line

FOSTER HILL RD

N/F WINN, GREGORY H.
Map 42 Lot 1

N/F PUSHEE, EUGENE S.
Map 42 Lot 5

N/F PUSHEE, EUGENE S.
Map 42 Lot 6

N/F EMMONS, MARK H.
Map 42 Lot 2

N/F LOZEAU, KENNETH R.
Map 42 Lot 7

N/F TRANSCANADA HYDRO NORTHEASST INC
Map 29 Lot 8

- Existing Structure
- Existing Transmission Line
- Existing Treeline
- Delineated Wetland Edge
- Wetland Resource Area
- Ditch
- Stream
- Assessor's Tax Parcels

Source:
NGRID T-SHEETS
VHB

0 200 400 Feet

C203 New 230 kV Tap Line

Littleton Substation
Foster Hill Road
Littleton, New Hampshire

nationalgrid

VHB
Vanasse Hangen Brustlin, Inc.

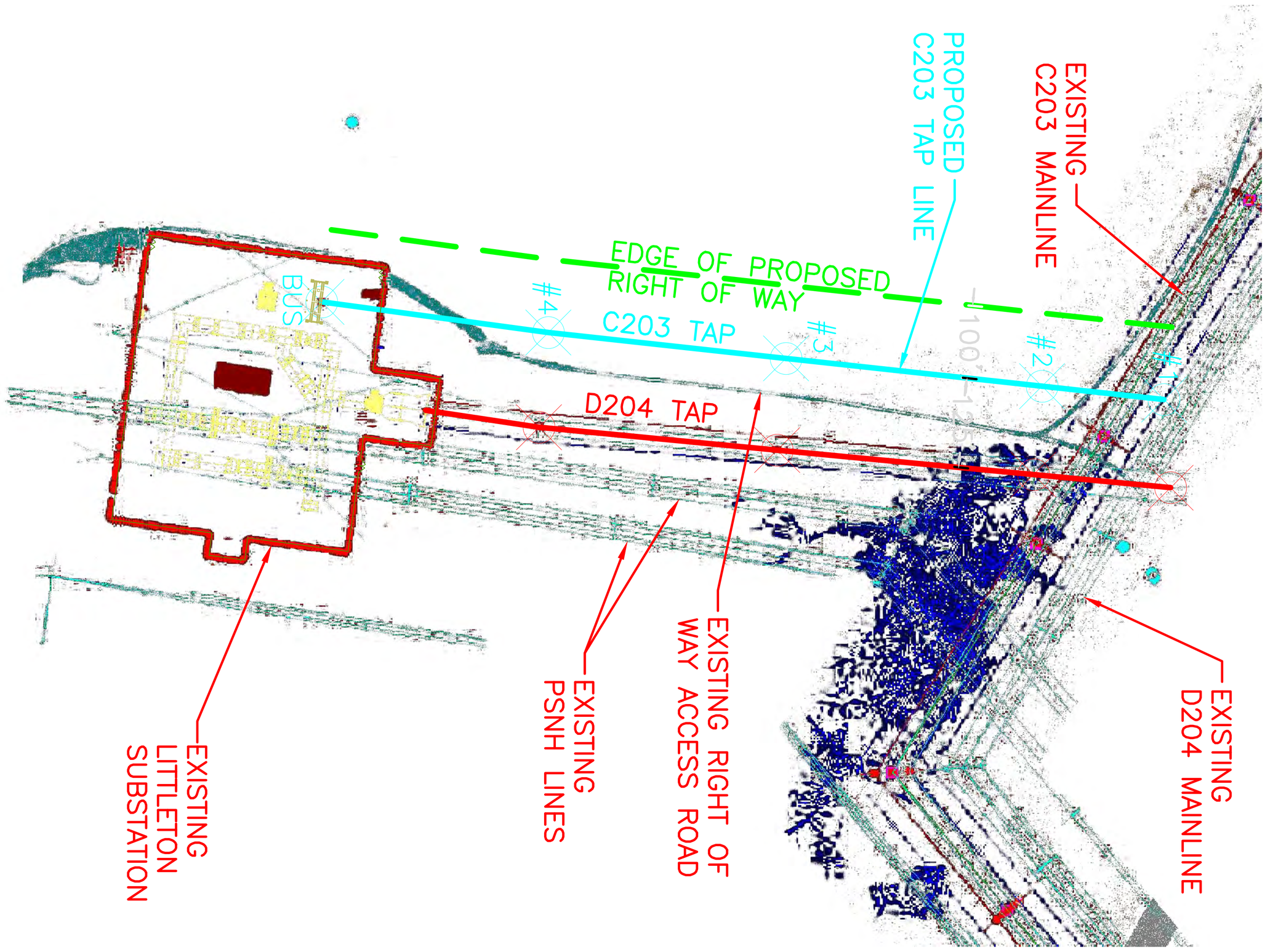
THIS DOCUMENT IS INTENDED FOR GENERAL PLANNING & INFORMATION PURPOSES ONLY. ALL MEASUREMENTS & LOCATIONS ARE APPROXIMATE

Appendix B

Post-Project Power Line Configuration Near Littleton Substation

N

PLAN VIEW



PROPOSED C203 TAP STRUCTURE

EXISTING D204 TAP STRUCTURE

C203 NEW 230KV TAP AT LITTLETON SUB

LOCUS MAP

PREPARED BY	GJB	7/16/13
REVIEWED BY		
APPROVED BY		
SCALE	1" = 1'-0"	
SHEET	1 OF 1	
INDEX		

nationalgrid

VER	DATE	VERSION DESCRIPTION	PREPARED	REVIEWED	APPROVED	VERSION
1	7/16/13	INITIAL RELEASE	GJB			1
2						
3						
4						
5						
6						
7						

INCHES ON ORIGINAL

PRINTED 8/2/2013 1:20 PM