Maryland State Highway Administration

Level-Top Methodology

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Summary of Presentation

- Discussing Uniform-Height Design Method

- Explaining Level-Top Design Method

- Examples to compare

- How this relates to MD

Uniform-Height Methodology

- Noise reduction is the primary focus

- Larger/ variable segment lengths

- Top of wall elevation mimics ground elevations
  - *Creates sloped panels when optimizing*

- "Bottom Up" design approach

- Line of sight an afterthought
  - *Sloped panel may result in false LOS needs*

- Underestimates the 'cost' analysis
  - *Planning to Design may have major 'cost' differences*
  - *Policy implications (reasonableness determination)*
  - *Funding issues (County participation in Type II funding)*

Example of Uniform-Height
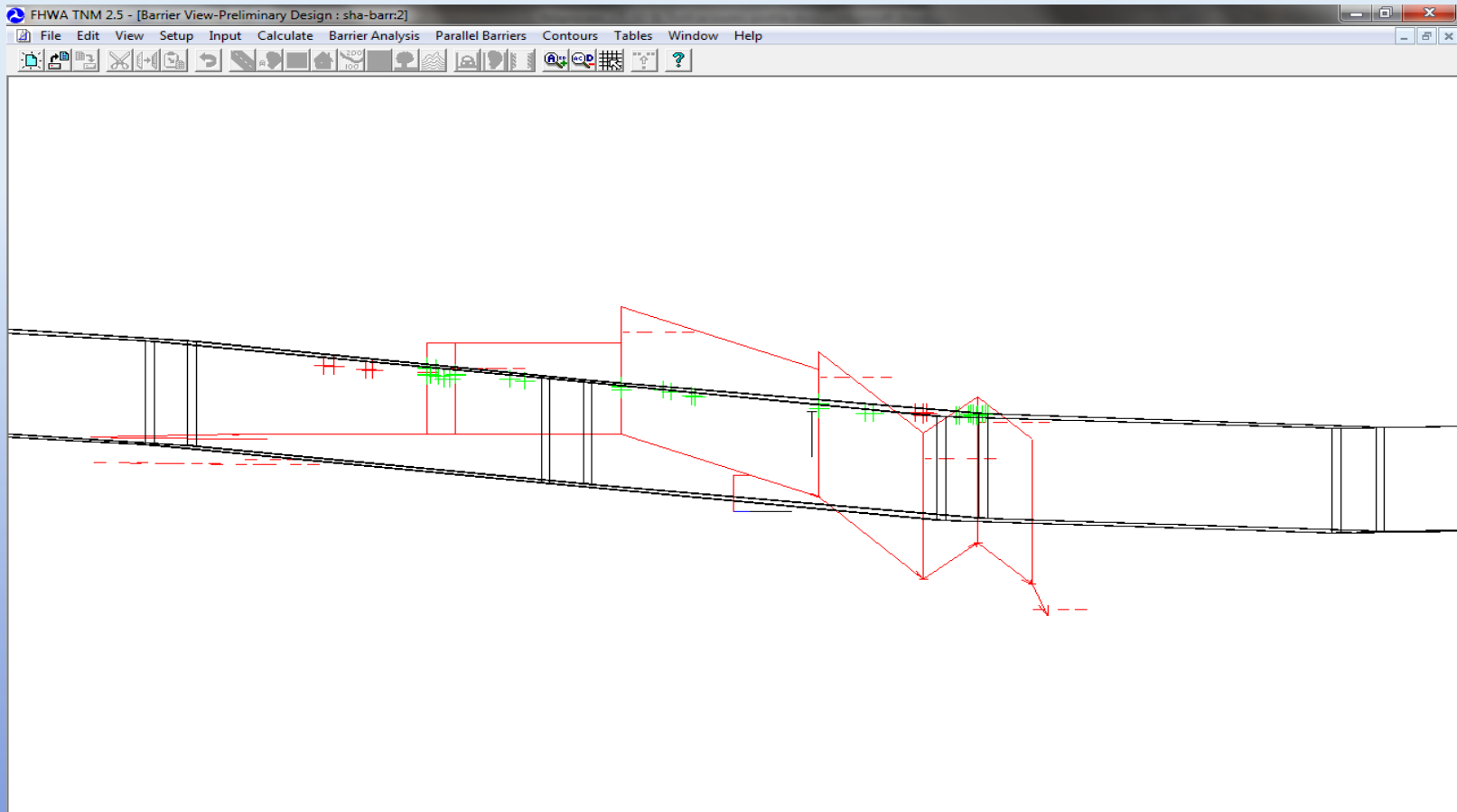
Level-Top Methodology

- Develop a more detailed/comprehensive design profile that meets both the l-o-s profile and the noise reduction profile
    - *2700 SF/benefit was based on bid/built quantities and costs. Therefore, it included "design profile" approach.*

- Horizontal alignment considers known engineering constraints

- Regular/ shorter barrier segments

- Considers top of wall stepping scheme

- Perturbations – limited/ more focused

- "Top Down" design approach

- Line of sight requirement is a starting point
    - *More accurate because there are no sloped panels*

- More accurate reporting of noise reductions and benefits
    - *If project shelved, more accurate design to use later, which should expedite the engineering process.*
    - *Planning to Design transition results in more comparable results*
    - *More accurate 'cost' for funding purposes*

Example of Level-Top Methodology
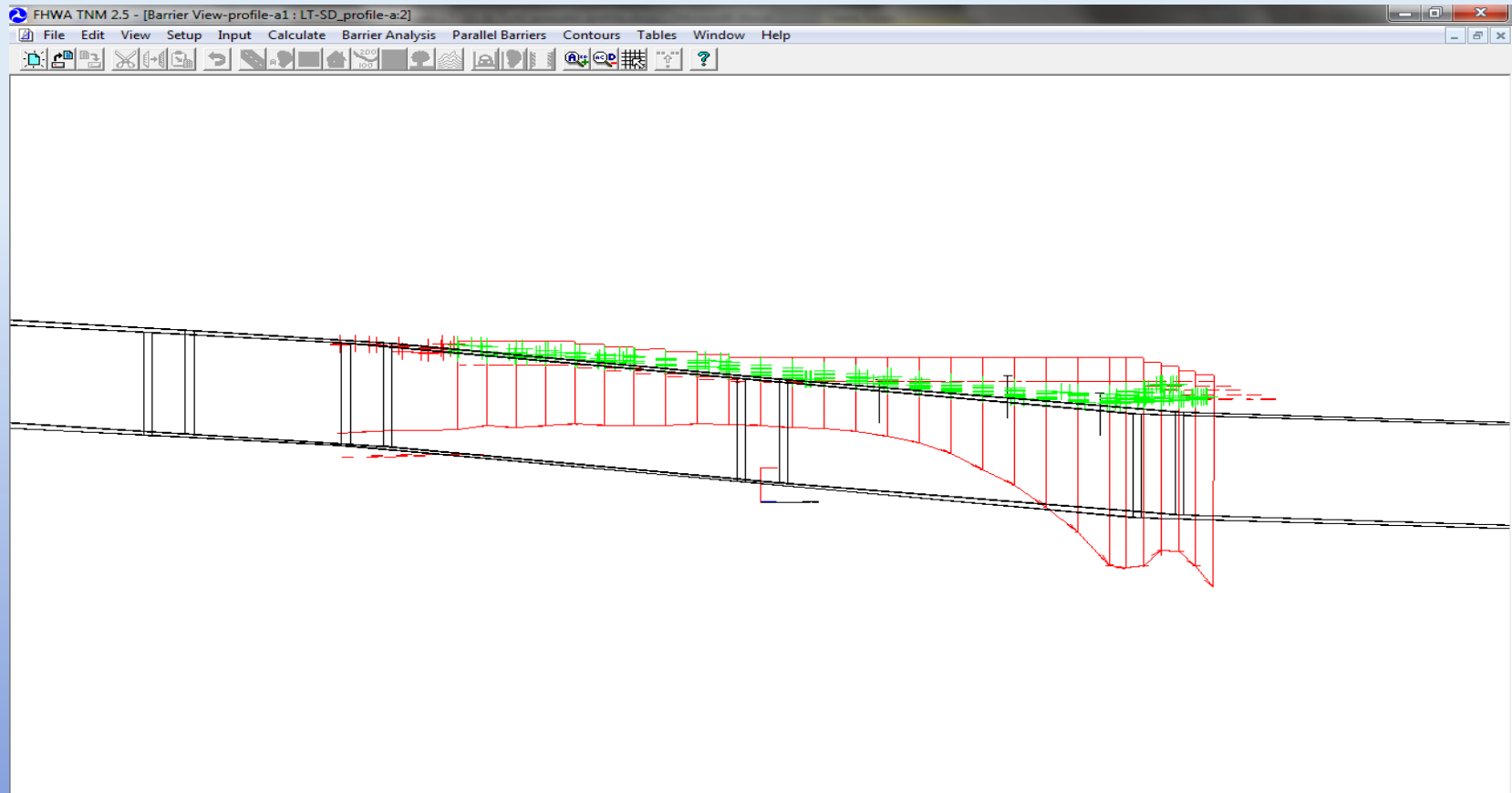
Level-Top Process

- Layout using 16 foot segments
    - *Typical panel dimension standard in MD*
- Level-Top "baseline" Top of Wall (ToW) elevation typically defined as the highest ground elevation along the barrier alignment + 24 feet.
    - *Barrier height varies at each segment to reach LT baseline ToW elevation*
- Determine critical sensitive and limit receptors
    - *Generally impacted receptors or those just below the impact threshold*
- Perform line-of-sight (l-o-s) for each individual critical sensitive and limit receptor within TNM.

Level-Top Process Continued

- Minimum l-o-s for entire barrier determined by spreadsheet.

- Smooth out line-of-sight profile for any obvious atypical "dips".

- Develop a design profile from the smooth l-o-s profile that is consistent with MD SHA's stepping guidelines.

- Run the design profile in TNM <u>using one perturbation per segment (level-top single-drop)</u> to evaluate noise reduction goals with spreadsheet. Modify profile iteratively until design goals are achieved at remaining critical sensitive receptors.
  - *Subsequent profile runs may only be for a limited number of receptors.*

Uniform-Height Input
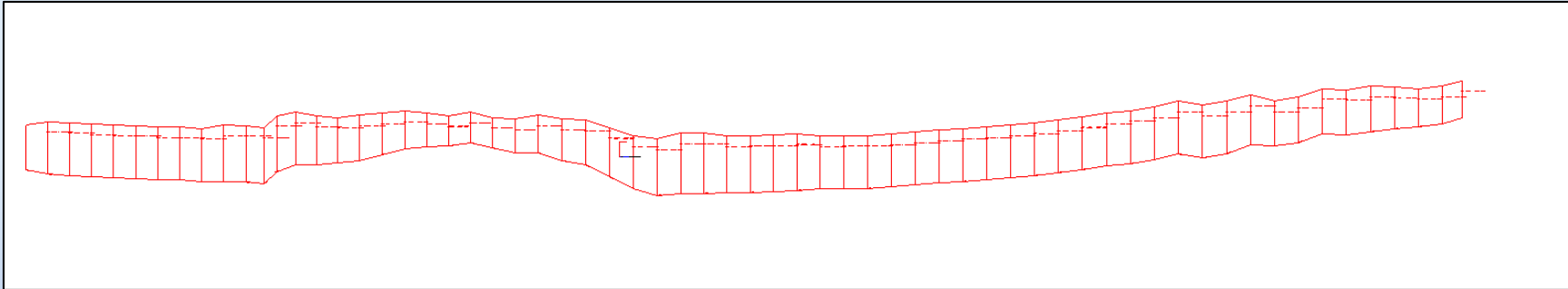
	Pnt.Name	Pnt.No	X [ft]	Y [ft]	Z(bottom) [ft]	Height [ft]	Increment [ft]	#Up	#Dn
59	point677	677	1,384,637.6	603,875.9	408.00	15.00	2.00	3	3
60	point678	678	1,384,637.6	603,907.9	408.28	15.00	2.00	3	3
61	point679	679	1,384,637.5	603,939.9	409.94	15.00	2.00	3	3
62	point680	680	1,384,637.5	603,971.9	410.00	15.00	2.00	3	3
63	point681	681	1,384,637.5	604,003.9	410.00	15.00	2.00	3	3
64	point682	682	1,384,637.4	604,035.9	411.34	15.00	2.00	3	3
65	point683	683	1,384,637.4	604,067.9	412.00	15.00	2.00	3	3
66	point684	684	1,384,637.3	604,099.9	412.00	15.00	2.00	3	3
67	point685	685	1,384,637.3	604,131.9	412.67	15.00	2.00	3	3
68	point686	686	1,384,637.1	604,163.9	413.77	15.00	2.00	3	3
69	point687	687	1,384,637.1	604,195.9	414.00	15.00	2.00	3	3
70	point688	688	1,384,637.0	604,227.9	414.83	15.00	2.00	3	3
71	point689	689	1,384,637.0	604,259.9	415.85	15.00	2.00	3	3
72	point690	690	1,384,636.9	604,291.9	416.00	15.00	2.00	3	3
73	point691	691	1,384,636.9	604,323.9	416.32	15.00	2.00	3	3
74	point692	692	1,384,636.8	604,355.9	417.52	15.00	2.00	3	3
75	point693	693	1,384,636.8	604,387.9	418.00	15.00	2.00	3	3
76	point694	694	1,384,636.6	604,419.9	418.41	15.00	2.00	3	3
77	point695	695	1,384,636.6	604,451.9	419.48	15.00	2.00	3	3
78	point696	696	1,384,636.5	604,483.9	420.00	15.00	2.00	3	3
79	point697	697	1,384,636.5	604,515.9	420.32	15.00	2.00	3	3
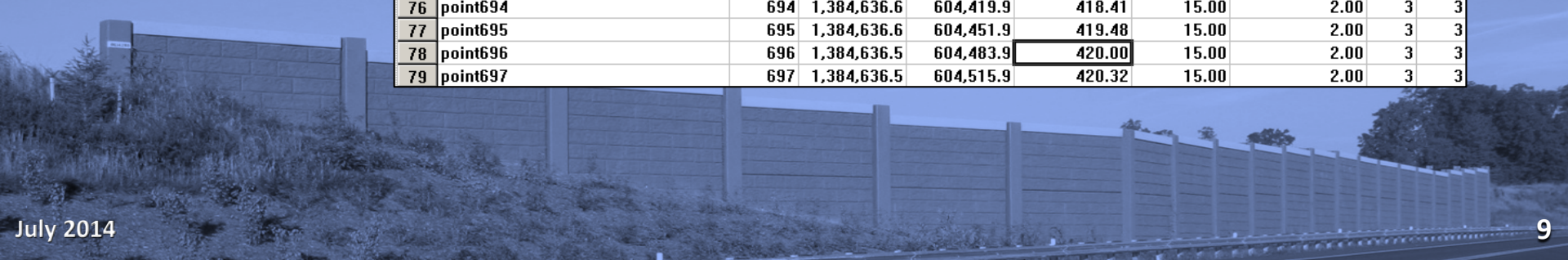
Level-Top: l-o-s input

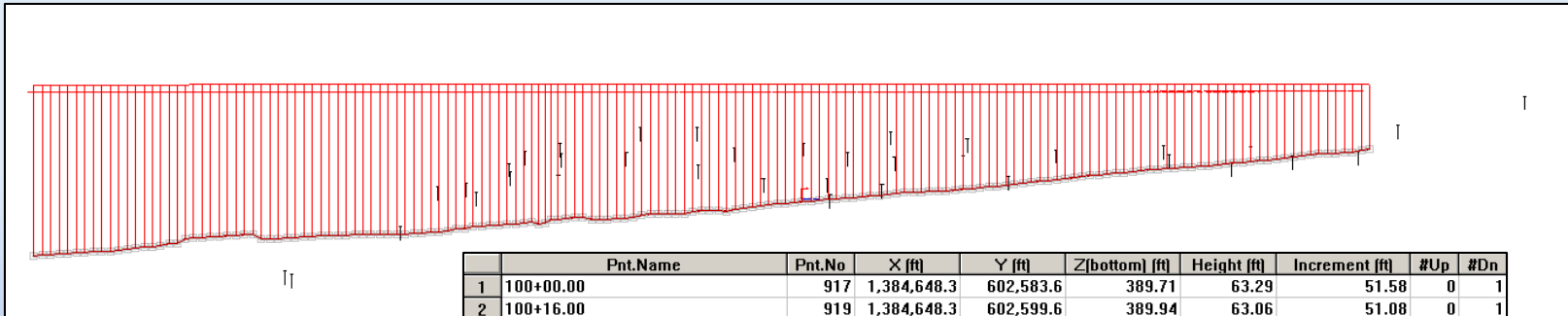|	Pnt.Name	Pnt.No	X [ft]	Y [ft]	Z[bottom] [ft]	Height [ft]	Increment [ft]	#Up	#Dn
1	100+00.00	917	1,384,648.3	602,583.6	389.71	63.29	1.00	0	56
2	100+16.00	919	1,384,648.3	602,599.6	389.94	63.06	1.00	0	56
3	100+32.00	920	1,384,648.1	602,615.6	390.13	62.87	1.00	0	55
4	100+48.00	921	1,384,648.1	602,631.6	390.34	62.66	1.00	0	55
5	100+64.00	922	1,384,648.0	602,647.6	390.60	62.40	1.00	0	55
6	100+80.00	923	1,384,647.9	602,663.6	390.84	62.16	1.00	0	55
7	100+96.00	924	1,384,647.8	602,679.6	391.03	61.97	1.00	0	54
8	101+12.00	925	1,384,647.8	602,695.6	391.19	61.81	1.00	0	54
9	101+28.00	926	1,384,647.8	602,711.6	391.35	61.65	1.00	0	54
10	101+44.00	927	1,384,647.6	602,727.6	391.47	61.53	1.00	0	54
11	101+60.00	928	1,384,647.5	602,743.6	391.81	61.19	1.00	0	54
12	101+76.00	929	1,384,647.5	602,759.6	392.21	60.79	1.00	0	53
13	101+92.00	930	1,384,647.4	602,775.6	392.60	60.40	1.00	0	53
14	102+08.00	931	1,384,647.3	602,791.6	392.85	60.15	1.00	0	53
15	102+24.00	932	1,384,647.3	602,807.6	393.16	59.84	1.00	0	52
16	102+40.00	933	1,384,647.3	602,823.6	393.47	59.53	1.00	0	52
17	102+56.00	934	1,384,647.1	602,839.6	394.04	58.96	1.00	0	51
18	102+72.00	935	1,384,647.0	602,855.6	394.40	58.60	1.00	0	51
19	102+88.00	988	1,384,641.8	602,870.7	395.98	57.02	1.00	0	50
20	point991	991	1,384,641.6	602,886.7	396.18	56.82	1.00	0	49
21	point992	992	1,384,641.6	602,902.7	396.39	56.61	1.00	0	49
22	point993	993	1,384,641.5	602,918.7	396.59	56.41	1.00	0	49
23	point994	994	1,384,641.5	602,934.7	396.79	56.21	1.00	0	49
24	point995	995	1,384,641.4	602,950.7	397.00	56.00	1.00	0	49
25	point996	996	1,384,641.3	602,966.7	397.20	55.80	1.00	0	48
26	point997	997	1,384,641.3	602,982.7	397.41	55.59	1.00	0	48
27	104+16.00	989	1,384,641.1	602,998.7	397.61	55.39	1.00	0	48
28	104+32.00	950	1,384,646.3	603,013.8	395.83	57.17	1.00	0	50
29	104+48.00	951	1,384,646.3	603,029.8	396.02	56.98	1.00	0	49
30	104+64.00	952	1,384,646.3	603,045.8	396.05	56.95	1.00	0	49
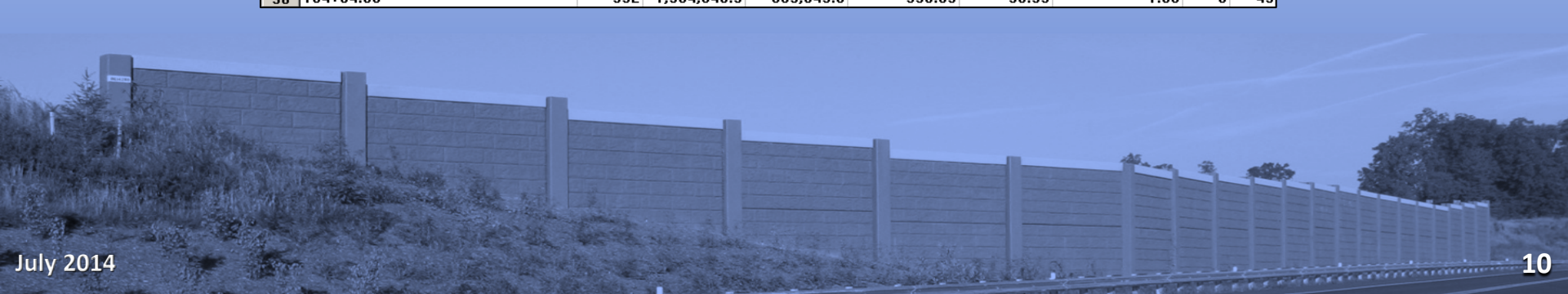
Level-Top l-o-s

- l-o-s analysis completed *before* TNM run is calculated.

- Receivers can be analyzed individually.

- Provides the base height from which the acoustical profile is verified.

- Provides l-o-s needed for each panel for a more in depth analysis.
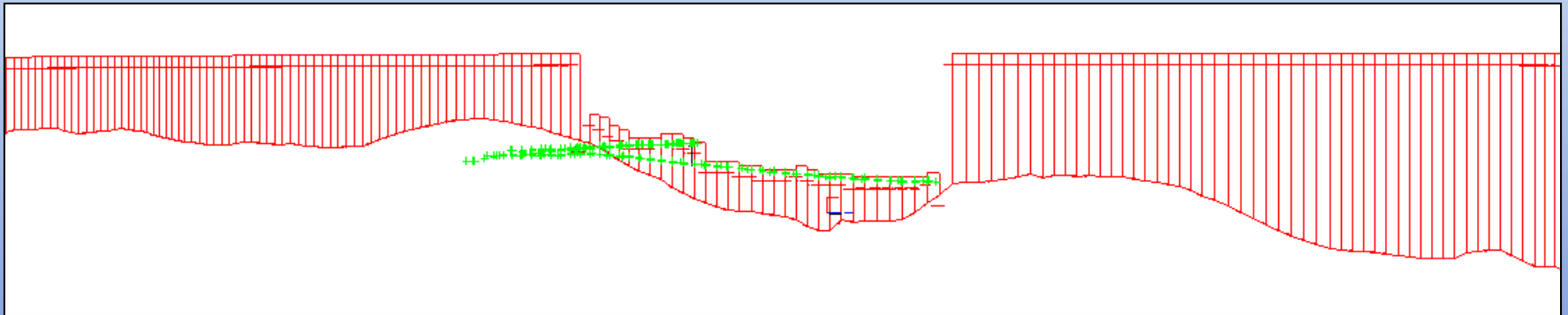
Level-Top Design Profile Input

	Pnt.Name	Pnt.No	X [ft]	Y [ft]	Z[bottom] [ft]	Height [ft]	Increment [ft]	#Up	#Dn
1	100+00.00	917	1,384,648.3	602,583.6	389.71	63.29	51.58	0	1
2	100+16.00	919	1,384,648.3	602,599.6	389.94	63.06	51.08	0	1
3	100+32.00	920	1,384,648.1	602,615.6	390.13	62.87	50.58	0	1
4	100+48.00	921	1,384,648.1	602,631.6	390.34	62.66	50.08	0	1
5	100+64.00	922	1,384,648.0	602,647.6	390.60	62.40	49.58	0	1
6	100+80.00	923	1,384,647.9	602,663.6	390.84	62.16	49.08	0	1
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12	101+76.00	929	1,384,647.5	602,759.6	392.21	60.79	46.08	0	1
13	101+92.00	930	1,384,647.4	602,775.6	392.60	60.40	45.58	0	1
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16	102+40.00	933	1,384,647.3	602,823.6	393.47	59.53	44.08	0	1
17	102+56.00	934	1,384,647.1	602,839.6	394.04	58.96	43.58	0	1
18	102+72.00	935	1,384,647.0	602,855.6	394.40	58.60	43.08	0	1
19	102+88.00	988	1,384,641.8	602,870.7	395.98	57.02	42.58	0	1
20	point991	991	1,384,641.6	602,886.7	396.18	56.82	42.08	0	1
21	point992	992	1,384,641.6	602,902.7	396.39	56.61	41.83	0	1
22	point993	993	1,384,641.5	602,918.7	396.59	56.41	41.58	0	1
23	point994	994	1,384,641.5	602,934.7	396.79	56.21	41.33	0	1
24	point995	995	1,384,641.4	602,950.7	397.00	56.00	41.08	0	1
25	point996	996	1,384,641.3	602,966.7	397.20	55.80	40.83	0	1
26	point997	997	1,384,641.3	602,982.7	397.41	55.59	40.58	0	1
27	104+16.00	989	1,384,641.1	602,998.7	397.61	55.39	40.33	0	1
28	104+32.00	950	1,384,646.3	603,013.8	395.83	57.17	39.83	0	1
29	104+48.00	951	1,384,646.3	603,029.8	396.02	56.98	39.33	0	1
30	104+64.00	952	1,384,646.3	603,045.8	396.05	56.95	38.83	0	1

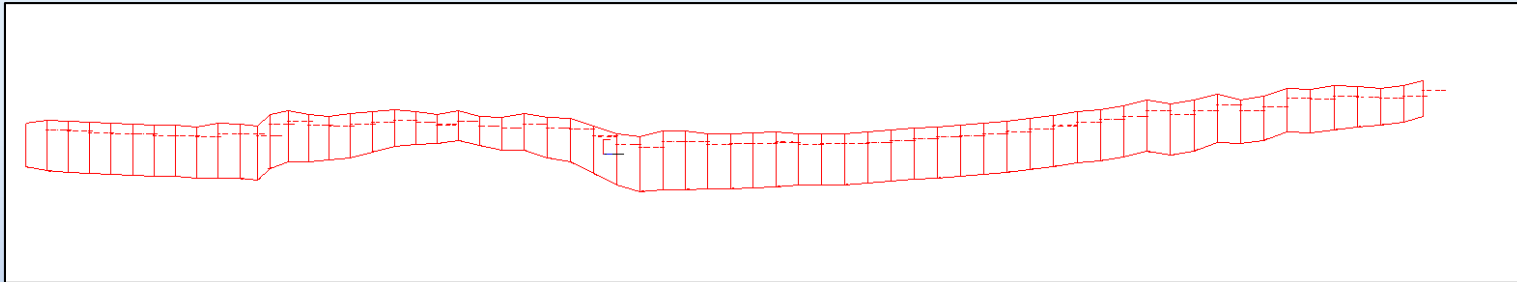# Level-Top Single-Drop: One Perturbation
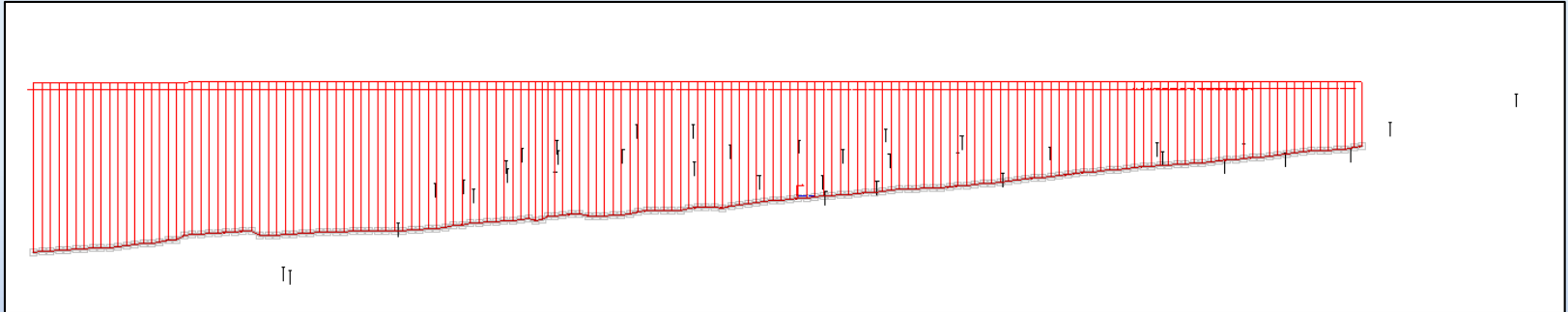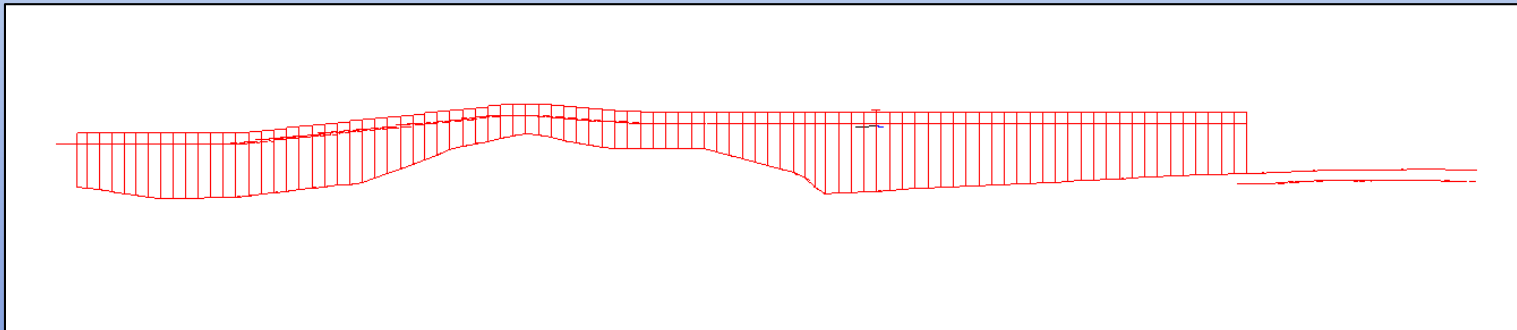

Level Top Barrier before perturbation
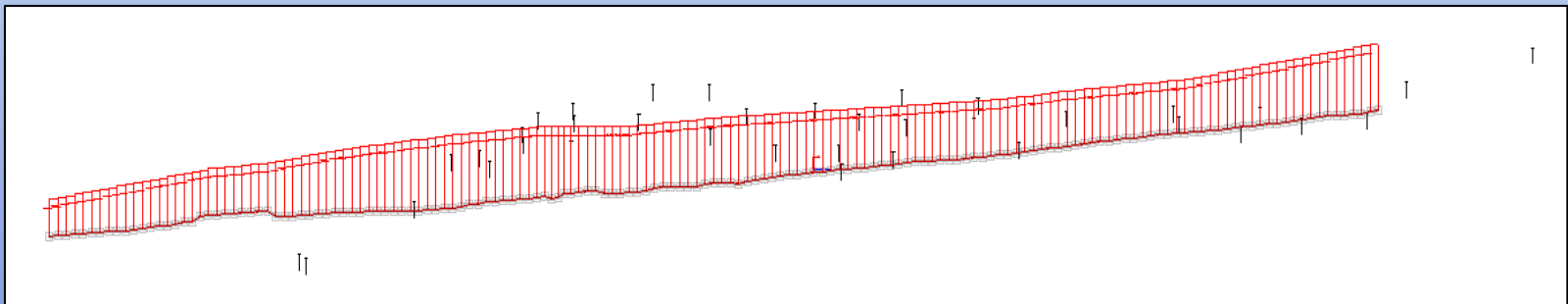
One perturbation down

Comparison of Uniform-Height vs. Level-Top

6 Perturbations at 64 Panels = 512 Total Perturbations

1 Perturbation at 168 Panels = 168 Total Perturbations

Uniform-Height vs. Level-Top Overview

Uniform-Height

- TNM Program Default

- Main focus is on meeting noise reduction goals

- Irregular/long barrier segments

- Perturbations – larger range of values

- Bottom up design

- L-o-s check at end

- Less accurate reporting of noise reductions and benefits

Level -Top

- MDSHA Preferred Method

- Main focus is on meeting noise reduction goals and line-of-sight (l-o-s)

- Regular/ short barrier segments

- Perturbations – limited/ more focused

- Top down approach

- L-o-s check at beginning

- More accurate reporting of noise reductions and benefits

Summary

- More comprehensive analysis

- Can be completed for any size project, at any stage of project

- More accurate results that lead to more confident decisions

- "More from the same effort"