Summary of AERMOD Implementation Workgroup (AIWG) Case Studies for 1-hour NO2 and SO2 NAAQS

In 2011, EPA redirected the AERMOD Implementation Workgroup (AIWG) with a focus on the new 1-hour NO_2 and SO_2 NAAQS. The purpose of the workgroup was to provide insight into the potential challenges in modeling compliance under the new standards by working with "real world" examples. These examples would then provide a valuable basis to assess EPA's existing guidance for NO_2 and SO_2 as well as indicate areas for new guidance. The AIWG workgroup was composed of over 50 members with EPA staff from the Regional offices and the Office of Air Quality Planning and Standards (OAQPS), and modelers from state, territorial, and local air quality agencies (see Table 4 for full list of members). The workgroup was co-chaired by Erik Snyder of Region 6 and James Thurman of OAQPS.

The workgroup was charged with completing its work in two phases:

1. Single source modeling case studies,
2. Cumulative modeling scenarios involving multiple facilities and background concentrations

For the first phase, the workgroup compiled a list of facilities that were of most interest to various state and local agencies. The workgroup began with an initial list of facility types and then workgroup members focused on those facility types that were of interest in their state or local area. Table 1 lists the final list of facility types that were modeled by the workgroup as part of the first phase.

Table 1. Facilities, pollutants and modelers of single source modeling scenarios.

Facility Type	**Pollutant(s)**	**Modeler(s)**
Secondary steel mill	NO_2	Doris Jung (CO)
Ethanol plant	NO_2, SO_2	Dawn Froning (MO); Jennifer Krzak (IA)
Materials recycler	NO_2	Steven Sherman (IN)
Natural gas turbine	NO_2	Margaret Valis (NY); Bruce Ferguson (MS)
Coal fired EGU	NO_2, SO_2	Eric Milligan (OK); James Thurman (EPA-OAQPS)
Biomass facility	NO_2	Dennis Becker (MN)
Natural gas processing plant	NO_2	Krystin Bablinskas (AK); Andy Hawkins (EPA-R7)
Refinery	NO_2, SO_2	Glenn Reed (SJV); Leland Villalvazo (SJV)
Natural gas compressors	NO_2	Ashley Mohr (EPA-R6); Erik Snyder (EPA-R6); Chiu Foong (EPA-R6)
Cement kiln	NO_2	Dawn Froning (MO); Tracy Price (SC)
Landfill gas turbine	NO_2	Lisa Landry (NH); Todd Moore (NH)

Fuel oil turbine	NO_2	Haidar Al-Rawi (TN)
Pulp & paper	SO_2	Leigh Bacon (AL); Jim Owen (AL)
Flare	SO_2	Annamaria Coulter (EPA-R2)

For each modeled facility, emissions and source parameters were based on real facilities but were modified by the workgroup to be a generic facility type. For each facility type, there were several modeling scenarios such as addition of controls, changing stack height, varying fence-line distances, etc. Also for NO_2 sources, modeling scenarios involved comparing the use of the Plume Volume Molar Ratio Method (PVPRM) and Ozone Limiting Method (OLM) techniques within AERMOD as the approaches to model NOx to NO_2 conversion. Details about the modeling inputs for each scenario are provided for each facility type in Appendix A.

Summary of findings

A listing of modeled sources with maximum design values for multiple scenarios can be found in Table 2 for NO_2 and Table 3 for SO_2. A more detailed listing of maximum design values across scenarios for each modeled facility type can be found in Appendix A, which also contains spatial plots for several of the modeled sources. Based on the results of the modeling results, several preliminary observations have been made:

1. Many factors may contribute to NAAQS violations in addition to emissions levels. Other variables such as distance to ambient air (ethanol plant scenarios), urban/rural classification (NO_2 refinery and biomass facility), presence of terrain (refinery), meteorology, downwash influences, and stack heights can affect design value concentrations.
2. Short stacks and small facility footprints (SO_2 ethanol plant) can be problematic in attaining the NAAQS with violations occurring just beyond the fenceline. However, the area showing potential modeled violations in these cases may be very small.
3. In some cases the largest units in terms of emissions are not the major contributors to the maximum design values. Modeling scenarios where controls or stack height changes were made to the larger emitting stacks at times did not affect the maximum design value concentration, which were dominated by smaller units with short stacks (e.g., ethanol plant, coal fired EGU).
4. Increasing stack heights (within GEP regulations) for some sources with short stacks may be as effective as additional emission controls in eliminating modeled violations.
5. For NO_2, modeling results highlight the importance of the use of the OLM or PVMRM Tier 3 options, the initial NO_2/NOx in-stack ratio, and input ozone background concentrations to modeled design values.

Table 2. NO_2 modeling results

Facility	Emissions (tpy)	Maximum DV (μg/m^3) (ppb)	Sensitivity test	Maximum DV (μg/m^3) (ppb)	Comments
Steel mill	Base: 711	318 (169) – OLM; 300(160)- PVMRM; < 1% receptors exceed	65 m stack ht (units > 1 g/s). Emissions unchanged.	128 (68) – OLM; 250 (133) – PVMRM; 1 receptor exceeds	Sensitivity to NOx to NO_2 method
Ethanol plant	Base: 1,180	1,289 (685); 5% receptors exceed	NO_2/NOx ratio 0.5, controls & increased stack ht on one unit; Emissions: 170 tpy	1,289 (685); 5% receptors exceed	50 m fenceline; no change in maximum DV with controls & stack ht increase
Materials recycler	Base: 70	401 (214); NO_2/NOx ratio 0.2; < 1% receptors exceed	Stack ht increase (> 25 m); Emissions unchanged	17 (9)	Violations < 500 m for base case.
Natural gas turbine (NY)	Base: 450	145 (77)	Increase stack ht & controls (390 tpy)	122 (65)	No downwash
Natural gas turbine (MS)	Base: 450	16 (8)	Increase stack ht & controls (390 tpy)		No downwash
Coal EGU	Base 1,870	234 (125); < 1% receptors exceed	Stack ht increase, controls & higher exit velocity (610 tpy)	234 (125); < 1% receptors exceed	No change in maximum DV with controls & stack ht increase
Biomass facility	Base: 240	22 (11)	Stack height increase & no controls (1,220 tpy)	45 (24)	Sensitivities to urban/rural classification & NOx to NO_2 algorithm.
Natural gas processing plant	Uncontrolled: 3,190	1,440 (766); 60% receptors exceed	Increase stack ht & controls (330 tpy)	85 (45)	
Refinery	Base: 8,770	189 (100)	Increase stack ht & controls (5200 tpy)	171 (91)	
Natural gas compressors	Uncontrolled (4069)	1,674 (890); 21% receptors exceed;	Increase stack ht & controls (626 tpy)	43 (23)	Violations < 7 km
Cement kiln	Base: 7,170	44 (24)	Controls (2,180 tpy)	8 (4)	
Landfill gas turbine	Base: 80	29 (15)	Increase stack ht; emissions unchanged	4 (2)	
Fuel oil turbine	Less controlled: 2,230	484 (257); 1% receptors exceed	Increase stack ht & controls (1,190 tpy)	337 (179); < 1% receptors exceed	Violations < 2 km

Table 3. SO_2 modeling results.

Facility	Emissions (tpy)	Maximum DV (μg/m^3) (ppb)	Sensitivity test	Maximum DV (μg/m^3) (ppb)	Comments
Ethanol plant	Base: 890	296 (113); 1 receptor exceed	65 m stack ht & controls on one unit (195 tpy)	296 (113); 1 receptor exceed	Sensitivity to fenceline distance. 300 m fenceline – no exceedances
Coal EGU (OAQPS)	Uncontrolled: 10,713	905 (346); < 1% receptors exceed	Stack increase, controls & higher exit velocity; Emissions 2,074 tpy	33 (13)	Exceedances < 8km; stack ht=65 m
Coal EGU (OK)	Base: 4,959	48 (18)	Stack increase, controls & higher exit velocity; Emissions 2,074 tpy	28 (11)	
Refinery	Base: 4,020	272 (104)	Stack height increases; emissions unchanged	36 (14)	Sensitivity to urban/rural classification and terrain
Cement kiln	Base: 3,129	34 (13)	Controls; Emissions 348 tpy	4 (2)	
Pulp & paper	Base: 3,403	924 (353); 28% receptors exceed	Stack height increase & controls; Emissions 1,630	212 (81); < 1% receptors violate;	Exceedances < 4 km for base case; Exceedances < 1 km for stack ht increase & controls
Landfill gas turbine	Base: 45	17 (7)	Stack height increases; Emissions unchanged	2 (0.8)	
Fuel oil turbine	Base: 417	257 (98); < 1% receptors exceed;	Stack height increases; Emissions unchanged	178 (63)	Base case exceedances 0.5 to 1 km from source
Flare	Base: 6,083	324 (124); < 1% receptors exceed	65 m stack ht & controls; Emissions 626 tpy	9 (4)	Exceedances 6 to 7 km from source

Table 4. AERMOD Implementation Workgroup (AIWG) Members.

Name	State	Region
Lisa Landry	NH	1
Todd Moore	NH	1
Ian Cohen	RO	1
Alan Dresser	NJ	2
Margaret Valis	NY	2
Elianeth Rivera	PR	2
Lucia Fernandez	PR	2
Annamaria Coulter	RO	2
Tim Leon-Guerrero	RO	3
Howard Schmidt	RO	3
Michael Kiss	VA	3
Robert Lute	VA	3
Jon McClung	WV	3
Jim Owen	AL	4
Leigh Bacon	AL	4
Cleve Holladay	FL	4
Melody Lovin	FL	4
Pete Courtney	GA	4
Bruce Ferguson	MS	4
Stan Krivo	RO	4
Tracy Price	SC	4
Eric McCann	TN	4
Haidar Al-Rawi	TN	4
Jeff Sprague	IL	5
Ken Ritter	IN	5
Steve Sherman	IN	5
Dennis Becker	MN	5
Ben Dutcher	OH-Dayton	5
Mary Portanova	RO	5
Randy Robinson	RO	5
Gail Good	WI	5

Name	State	Region
Yvette McGehee	LA	6
Eric Peters	NM	6
Eric Milligan	OK	6
Ashley Mohr	RO	6
Erik Snyder*	RO	6
Jennifer Krzak	IA	7
Sergio Guerra	KS	7
Assem Abdul	MO	7
Bern Johnson	MO	7
Dawn Froning	MO	7
Lisa Alam	NE	7
Andy Hawkins	RO	7
Doris Jung	CO	8
Cyra Cain	MT	8
Gail Tonnesen	RO	8
Josh Nall	WY	8
Glenn Reed	CA- SJV	9
Leland Villalvazo	CA- SJV	9
Ralph DeSiena	CA-San Diego	9
Steve Moore	CA-San Diego	9
Carol Bohnenkamp	RO	9
Scott Bohning	RO	9
Cleve Holladay	RO	9
Krystin Bablinskas	AK	10
Kevin Schilling	ID	10
Clint Bowman	WA	10
Ranil Dhammapala	WA	10
Jim Hodina	NA	NACAA
Misti Duvall	NA	NACAA
George Bridgers	NA	OAQPS
James Thurman*	NA	OAQPS
Roger Brode	NA	OAQPS
Tyer Fox	NA	OAQPS
** AIWG co-chairs*		

Appendix A: Model Inputs for Phase 1 Case Studies

Following are the model inputs for the various single source scenarios modeled by AIWG.

Steel mill

Pollutant(s): NO_2

Terrain: Yes

Meteorology: Alva, OK (2006-2010)

Ozone data: Oklahoma (2006-2010)

Scenarios:

1. Base
2. Increase in stack height to 45 for stack with emissions > 2 g/s (Stack ht 2)
3. Increase in stack height to 65 m for stacks with emissions > 2 g/s (Stack ht 3)

All scenarios modeled with 0.1 NO_2/NOx in-stack ratio and results were compared using OLM and PVMRM

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)
C1423	POINT	2	21	530	0.001	2	45	65
C1424	POINT	2	21	530	0.001	2	45	65
C1520	POINT	2	20	310	2	12	45	65
C1521	POINT	4	34	380	8	5	45	65
C1523	POINT	0.5	12	480	0.01	1	12	12
C1524	POINT	0.00005	67	290	10	0.4	67	67
C1525	POINT	2	52	510	6	2	52	65
C1526	POINT	3	27	810	5	3	45	65
C1528	POINT	2	54	690	10	2	54	65
C1529	POINT	0.3	33	460	7	1	33	33
C1530	POINT	0.1	33	490	6	0.5	33	33
C1531	POINT	0.3	33	480	7	1	33	33

Steel mill volume sources

Source	Type	NOx (g/s)	Center of volume (m)	σ_y (m)	σ_z (m)
C1532	VOLUME	0.2	25	35	23
C1522	VOLUME	1	38	7	1
C1527	VOLUME	1	24	62	14

Ethanol plant

Pollutant(s): NO_2, SO_2

Terrain: Yes

Meteorology: Moline, IL (2000-04), Springfield, MO (2005-09), St. Louis, MO (2005-09), and Waterloo, IA (2000-04)

Ozone: Moline: 0.067 ppm; Springfield, Hillcreset (2005-09); St. Louis, Maryland Heights (2005-09); Waterloo, 0.066 ppm

Scenarios (both pollutants):

1. Base
2. Increase stack height to 65 for C0004 (Stack ht 2)
3. Controlled emissions for C0004 with 65 m stack height (NOx 2 and SO_2 2 with Stack ht 2)
4. Additional controls for C0004 with 65 m stack height (NOx 3 and SO_2 3 with Stack ht 2)

All scenarios modeled with the following sensitivities:

1. 300 m vs. 50 m fenceline

Additionally for NO_2, the following were modeled:

2. 0.1 NO_2/NOx in-stack ratio for all sources vs. 0.05 ratio for C0004 and 0.1 for other sources
3. 0.25 NO_2/NOx in-stack ratio vs. 0.5 ratio for all sources (50 m fenceline only)

All scenarios modeled with four different meteorological datasets listed above.

Source	Type	NOx (g/s)	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	NOx 2 (g/s)	SO_2 2 (g/s)	NOx 3 (g/s)	SO_2 3 (g/s)
C0001	POINT	0.1	0.01	11	800	7	0.8	11	0.1	0.01	0.1	0.01
C0002	POINT	0.01	0.5	11	800	5	0.6	11	0.01	0.5	0.01	0.5
C0003	POINT	1.2	0.1	2	700	64	0.1	2	1.2	0.1	1.2	0.1
C0004	POINT	32	25	43	440	22	3	65	9	5	3	2.5

Ethanol plant volume source

Source	Type	NOx (g/s)	SO_2 (g/s)	Center of volume (m)	σ_y (m)	σ_z (m)
C0005	VOLUME	0.625401	0.005	25	2	16

Materials recycler

Pollutant(s): NO_2

Terrain: Flat

Meteorology: Indianapolis, IN (2006-10)

Scenarios:

1. Base
2. Increase stack heights #1 (Stack ht 2)
3. Increase stack heights #2 (Stack ht 3)

All scenarios modeled with 0.1 NO_2/NOx in-stack ratio, PVMRM, and 40 ppb ozone concentration.

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)
C0001	POINT	0.6	3	700	40	0.25	15	25
C0002	POINT	0.2	3	680	30	0.2	15	25
C0003	POINT	0.4	3	650	12	0.2	15	25
C0004	POINT	0.6	3.75	920	20	0.2	20	32
C0005	POINT	0.2	3	680	32	0.2	15	25

Natural gas turbine

Pollutant(s): NO_2

Terrain: Yes

Meteolology: NY – Poughkeepsie, NY (2006-10); MS – Mobile, AL (2005-09)

Ozone: NY – Millbrook, NY (2006-10); MS – Average seasonal/hour of day

Scenarios:

1. Base

2. Increase stack heights #1 (Stack ht 2)

3. Increase stack heights #2 (Stack ht 3)

4. Scenario 3 stack heights with controlled emissions (NOx 2 and Stack ht 3)

New York also modeled sensitivities

1. Base with 100% and 80% conversion

2. Base with OLM with 0.05 NO_2/NOx in-stack ratio (no downwash)

3. Scenarios 2-4 with PVMRM comparing 0.05 NO2/NOx ratio (with and without downwash) and 0.1 ratio (with downwash)

Mississippi modeled all scenarios with 0.05 NO2/NOx ratio and 0.1 ratio

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	NOx 2 (g/s)
C0001	POINT	3	25	700	25	4	45	65	2.4
C0002	POINT	3	25	700	25	4	45	65	2.4
C0003	POINT	3	25	700	25	4	45	65	2.4
C0004	POINT	1	25	400	12	3	45	45	1
C0005	POINT	1	25	400	12	3	45	45	1
C0006	POINT	1	25	400	12	3	45	45	1
C0007	POINT	1	25	400	12	3	45	45	1
H01	POINT	0.02	6	700	10	0.2	6	6	0.02
H02	POINT	0.02	6	700	10	0.2	6	6	0.02
H03	POINT	0.02	6	700	10	0.2	6	6	0.02

Coal EGU

Pollutant(s): NO_2, SO2

Terrain: Yes

Meteorology: OAQPS – Charleston, SC (2005-09); OK- Springfield, MO (2006-10)

Ozone: OAQPS – Spartanburg, SC; OK – NEOK (2006-10)

Scenarios:

1. Base
2. Increase stack heights #1 (Stack ht 2)
3. Controlled emissions with base stack heights (NOx 2 and SO_2 2 with Stack ht 1)
4. Scenario 2 stack heights with controlled emissions (NOx 2 and SO_2 2 and Stack ht 2)
5. Scenario 3 emissions with further increase in stack ht (NOx 2 and SO_2 2 and Stack ht 3)
6. Scenario 5 with higher exit velocity and new diameter ((NOx 2 and SO_2 2, Stack ht 3, Stack velocity 2 and Diameter 2)

Note, controlled emissions for Oklahoma modeling for SO2 were 112 g/s. OAPQS also modeled all NO2 scenarios with 100% and 80% conversion. OAQPS also modeled all SO2 scenarios with uncontrolled emissions (290 g/s) for C0001. For SO2, OAQPS modeled the base scenario with a 65 m stack height for base emissions and uncontrolled emissions.

Source	Type	NOx (g/s)	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	NOx 2 (g/s)	SO_2 2 (g/s)	Stack velocity 2 (m/s)	Diameter 2 (m)
C0001	POINT	45	140	150	350	25	7	200	250	9	57	30	6
C0002	POINT	5	2.5	100	600	20	2	140	25	5	2.5	30	1.5
C0003	POINT	3	0.125	6	700	45	0.3	6	25	3	0.125	45	0.3
C0004	POINT	0.3	0.02	5	700	45	0.15	5	25	0.3	0.02	45	0.15
C0005	POINT	0.3	0.01	5	700	45	0.15	5	25	0.3	0.01	45	0.15

Biomass facility

Pollutant(s): NO_2

Terrain: Flat
Meteorology: Twin-Cities, MN (2006-10);

Ozone: 40 ppb

Scenarios:

1. Base

2. Increase stack heights #1 (Stack ht 2)

3. Scenario 2 stack heights with no controls on emissions (NOx 2 and Stack ht 2)

All three scenarios were also modeled with the following sensitivities:

1. Urban vs. rural

2. 100% and 80% conversion

3. OLM vs. PVMRM with 0.1 NO_2/NOx in-stack ratio

4. OLM vs. PVMRM with 0.15 NO_2/NOx in-stack ratio

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	NOx 2 (g/s)
C0001	POINT	7	55	400	18	2	80	35
C0002	POINT	0.01	9	780	105	0.2	9	0.01
C0003	POINT	0.01	9	710	52	0.2	9	0.01

Natural gas processing plant

Pollutant(s): NO_2

Terrain: Flat

Meteorology: Barrow, AK (2001-05)

Ozone: AK hourly data and 40 and 80 ppb constant concentrations

Scenarios:

1. Base
2. Increase stack heights #1 (Stack ht 2)
3. Increase stack heights #2 (Stack ht 3)
4. Increase stack heights #3 (Stack ht 4)
5. Base stack parameters with uncontrolled emissions (NOx 2 and Stack ht 1)

All scenarios modeled with PVMRM with the following in-stack ratios:

1. 0.1 vs. 0.25

The base scenario was also modeled with a 0.25 NO_2/NOx in-stack ratio and using a constant ozone concentration of 40 vs. 80 ppb.

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	Stack ht 4 (m)	NOx 2 (g/s)
C0001	POINT	0.1	6	530	3	0.6	6	6	6	1
C0002	POINT	1	8	650	19	1	17	35	55	10
C0003	POINT	0.5	7	830	26	0.3	7	35	55	5
C0004	POINT	1	8	650	19	1	17	35	55	10
C0005	POINT	1	8	730	37	0.4	17	35	55	10
C0006	POINT	1	8	650	19	1	17	35	55	10
C0007	POINT	0.7	6	840	35	0.3	17	35	55	7
C0008	POINT	1	7	730	39	0.3	17	35	55	10
C0009	POINT	1	8	730	37	0.4	17	35	55	10
C0010	POINT	0.6	7	720	33	0.3	17	35	55	6
C0011	POINT	0.6	7	720	33	0.3	17	35	55	6
C0012	POINT	0.6	7	720	33	0.3	17	35	55	6
C0013	POINT	0.01	6	530	2	0.2	6	6	6	0.01
C0014	POINT	0.04	17	1280	20	0.4	17	17	17	0.04
C0015	POINT	0.1	6	530	4	1	6	6	6	0.1
C0016	POINT	0.2	6	530	3	1	6	6	6	0.2

Refinery

Pollutant(s): NO_2, SO_2

Terrain: Flat, Elevated

Meteorology: Bakersfield, CA (2005-09)

Ozone: Bakersfield, CA (2005-09)

Scenarios:

For NO_2:

1. Base
2. Stack height increase #1 (Stack ht 2)
3. Stack height increase #2 (Stack ht 3)
4. Controlled emissions with base stack heights (NOx 2 and Stack ht 1)
5. Controlled emissions with Scenario 3 stack heights (NOx 2 and Stack ht 3)

All scenarios were modeled comparing OLM vs. PVMRM and flat vs. including terrain. The NO2/NOx in-stack ratio was 0.1

For SO_2:

1. Base
2. Stack height increase #1 (Stack ht 2)
3. Stack height increase #2 (Stack ht 3)

4. Uncontrolled emissions with Scenario 3 stack heights (NOx 2 and Stack ht 3)

5. Uncontrolled emissions with base stack heights (NOx 2 and Stack ht 3)

All SO_2 scenarios were modeled comparing urban vs. rural dispersion and flat vs. use of terrain.

NO_2 refinery emissions

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2(m)	Stack ht 3(m)	NOx 2 (g/s)
C0001	POINT	12	12	500	9	3	45	65	2.4
C0002	POINT	12	12	500	9	3	45	65	2.4
C0003	POINT	17	18	500	10	3	45	65	3.4
C0004	POINT	17	18	510	10	3	45	65	3.4
C0005	POINT	6	29	470	23	4	29	45	6
C0006	POINT	0.2	29	400	2	2	29	29	0.2
C0007	POINT	0.2	29	400	2	2	29	29	0.2
C0008	POINT	0.2	29	400	2	2	29	29	0.2
C0009	POINT	1	78	1300	20	4	78	78	1
C0010	POINT	0.1	48	500	4	0.7	48	48	0.1
C0011	POINT	0.04	48	500	5	0.5	48	48	0.04
C0012	POINT	6	49	510	12	3	49	49	6
C0013	POINT	4	45	510	10	3	45	45	4
C0014	POINT	2	45	600	6	2	45	45	2
C0015	POINT	1	41	640	5	2	41	41	1
C0016	POINT	2	47	650	8	2	47	47	2
C0017	POINT	0.5	41	650	3	2	41	41	0.5
C0018	POINT	17	76	480	25	2	76	76	3.4
C0019	POINT	1	30	700	12	1	30	30	1
C0020	POINT	0.5	30	700	7	1	30	30	0.5
C0021	POINT	1	54	700	9	2	54	54	1
C0022	POINT	1	44	550	6	0.7	44	44	1
C0023	POINT	19	54	560	50	2	54	65	3.8
C0024	POINT	3	24	440	25	2	24	24	3
C0025	POINT	2	18	400	13	2	18	18	2

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2(m)	Stack ht 3(m)	NOx 2 (g/s)
C0026	POINT	2	24	440	24	2	24	24	2
C0027	POINT	2	34	500	7	2	34	34	2
C0028	POINT	0.5	42	540	7	1	42	42	0.5
C0029	POINT	7	78	490	11	3	78	78	7
C0030	POINT	1	61	700	30	1	61	61	1
C0031	POINT	1	61	680	30	1	61	61	1
C0032	POINT	0.5	41	583	5	1	41	41	0.5
C0033	POINT	1	76	1300	20	0.3	76	76	1
C0034	POINT	2	0	1300	20	0.3	0	0	2
C0035	POINT	1	76	1300	20	0.3	76	76	1
C0036	POINT	1	76	1300	20	0.3	76	76	1
C0037	POINT	2	76	1300	20	0.4	76	76	2
C0038	POINT	1	76	1300	20	0.4	76	76	1
C0039	POINT	0.5	69	1300	20	1	69	69	0.5
C0040	POINT	2	49	620	9	2	49	49	2
C0041	POINT	2	49	590	9	2	49	49	2
C0042	POINT	1	49	570	5	2	49	49	1
C0043	POINT	1	49	600	5	2	49	49	1
C0044	POINT	3	55	560	8	3	55	55	3
C0045	POINT	0.5	34	600	3	2	34	34	0.5
C0046	POINT	0.5	34	620	3	2	34	34	0.5
C0047	POINT	0.2	0	250	0	0	0	0	0.2
C0048	POINT	8	49	470	27	4	49	49	8
C0049	POINT	1	34	850	9	2	34	34	1
C0050	POINT	1	34	1000	10	2	34	34	1
C0051	POINT	1	55	620	6	3	55	55	1
C0052	POINT	1	60	570	6	2	60	60	1

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2(m)	Stack ht 3(m)	NOx 2 (g/s)
C0053	POINT	11	31	530	34	2	45	31	2.2
C0054	POINT	1	30	750	20	1	30	30	1
C0055	POINT	0.5	30	760	7	1	30	30	0.5
C0056	POINT	0.5	40	505	5	2	40	40	0.5
C0057	POINT	2	56	530	6	3	56	56	2
C0058	POINT	2	56	520	6	3	56	56	2
C0059	POINT	11	108	450	12	4	108	108	2.2
C0060	POINT	2	60	570	12	2	60	60	2
C0061	POINT	2	46	500	27	1	46	46	2
C0062	POINT	2	46	500	27	1	46	46	2
C0063	POINT	2	46	500	27	1	46	46	2
C0064	POINT	0.3	44	600	12	1	44	44	0.3
C0065	POINT	0.5	63	500	12	1	63	63	0.5
C0066	POINT	0.2	43	490	12	1	43	43	0.2
C0067	POINT	0.4	42	600	12	1	42	42	0.4
C0068	POINT	3	81	500	6	3	81	81	3
C0069	POINT	3	81	500	6	3	81	81	3
C0070	POINT	3	81	500	6	3	81	81	3
C0071	POINT	4	68	480	10	3	68	68	4
C0072	POINT	1	46	480	10	1	46	46	1
C0073	POINT	2	61	430	10	1	61	61	2
C0074	POINT	1	46	680	14	1	46	46	1
C0075	POINT	3	37	520	39	2	37	37	3
C0076	POINT	3	37	520	40	2	37	37	3
C0077	POINT	3	37	520	39	2	37	37	3
C0078	POINT	0.1	16	580	12	0.3	16	16	0.1
C0079	POINT	5	30	750	14	2	30	45	5

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2(m)	Stack ht 3(m)	NOx 2 (g/s)
C0080	POINT	12	29	790	9	3	45	65	2.4
C0081	POINT	0.02	1	700	17	0.2	1	1	0.02
C0082	POINT	0.03	1	700	17	0.2	1	1	0.03
C0083	POINT	0.02	1	700	17	0.2	1	1	0.02
C0084	POINT	0.5	34	600	3	2	34	34	0.5

SO_2 refinery emissions

Source	Type	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 1 (m)	Stack ht 1 (m)	SO_2 2 (g/s)
C0001	POINT	0.3	14	480	6	2	14	14	0.3
C0002	POINT	0.3	14	480	6	2	14	14	0.3
C0003	POINT	0.5	46	600	6	3	46	46	0.5
C0006	POINT	0.4	39	780	5	2	39	39	0.4
C0007	POINT	0.2	46	670	5	3	46	46	0.2
C0009	POINT	0.03	22	480	4	1	22	22	0.03
C0010	POINT	0.06	45	480	3	2	45	45	0.06
C0011	POINT	0.08	43	480	4	2	43	43	0.08
C0015	POINT	0.12629	46	450	8	2	46	46	0.12629
C0017	POINT	0.2	52	480	14	1	52	52	0.2
C0018	POINT	0.3	45	480	6	2	45	45	0.3
C0020	POINT	0.05	14	500	4	2	14	14	0.05
C0024	POINT	0.1	46	480	8	1	46	46	0.1
C0029	POINT	1	58	500	7	1	58	65	1
C0030	POINT	2	58	500	7	1	58	65	2
C0031	POINT	0.3	32	1100	4	2	32	32	0.3
C0034	POINT	0.08	50	480	7	2	50	50	0.08
C0035	POINT	0.08	50	480	7	2	50	50	0.08
C0036	POINT	0.4	66	480	13	3	66	66	0.4
C0037	POINT	0.2	66	480	13	3	66	66	0.2
C0041	POINT	0.0003	9	1000	4	1	9	9	0.0003
C0043	POINT	4	58	500	12	2	58	65	50
C0044	POINT	0.000288	66	1270	20	5	66	66	0.000288
C0045	POINT	0.2	46	450	5	3	46	46	0.2
C0046	POINT	0.2	46	450	5	3	46	46	0.2

Source	Type	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 1 (m)	Stack ht 1 (m)	SO_2 2 (g/s)
C0048	POINT	0.01	23	1100	7	2	23	23	0.01
C0057	POINT	4	58	500	12	2	58	65	50
C0061	POINT	0.2	34	700	12	2	34	34	0.2
C0063	POINT	3	46	1270	20	14	46	65	3
C0064	POINT	0.3	46	1270	20	4	46	46	0.3
C0066	POINT	0.1	46	450	4	2	46	46	0.1
C0068	POINT	0.0003	18	1100	18	2	18	18	0.0003
C0069	POINT	0.0003	18	1100	18	2	18	18	0.0003
C0072	POINT	0.03	34	770	3	1	34	34	0.03
C0073	POINT	0.1	34	600	2	2	34	34	0.1
C0074	POINT	0.05	34	620	1	2	34	34	0.05
C0076	POINT	0.06	30	610	6	1	30	30	0.06
C0077	POINT	0.04	31	580	2	1	31	31	0.04
C0078	POINT	0.04	31	580	2	1	31	31	0.04
C0081	POINT	2	61	480	18	3	61	65	2
C0086	POINT	0.2	61	480	18	3	61	61	0.2
C0087	POINT	2	38	430	24	4	50	65	2
C0088	POINT	0.2	32	420	12	2	32	32	0.2
C0089	POINT	0.2	32	420	12	2	32	32	0.2
C0090	POINT	0.0004	1	250	0	0	1	1	0.0004

SO_2 refinery volume sources

Source	Type	SO_2 (g/s)	Center of volume (m)	σ_y (m)	σ_z (m)
C0004	VOLUME	0.00002	1	19	0.4
C0005	VOLUME	0.00002	1	5	0.4
C0008	VOLUME	0.00002	1	15	0.4
C0012	VOLUME	0.00002	1	12	0.4
C0013	VOLUME	0.00002	1	11	0.4
C0014	VOLUME	0.00002	1	11	0.4
C0016	VOLUME	0.00002	1	15	0.4
C0019	VOLUME	0.00002	1	23	0.4
C0021	VOLUME	0.00002	1	9	0.4
C0022	VOLUME	0.00002	1	24	0.4
C0023	VOLUME	0.00002	1	24	0.4
C0025	VOLUME	0.00002	1	11	0.4
C0026	VOLUME	0.00002	1	9	0.4
C0027	VOLUME	0.00002	1	16	0.4
C0028	VOLUME	0.00002	1	16	0.4
C0032	VOLUME	0.00002	1	14	0.4
C0033	VOLUME	0.00002	1	25	0.4
C0038	VOLUME	0.00002	1	17	0.4
C0039	VOLUME	0.00002	1	17	0.4
C0040	VOLUME	0.00002	1	7	0.4
C0042	VOLUME	0.00002	1	18	0.4
C0047	VOLUME	0.00002	1	39	0.4
C0049	VOLUME	0.00002	1	23	0.4
C0050	VOLUME	0.00002	1	23	0.4
C0051	VOLUME	0.00002	1	6	0.4
C0052	VOLUME	0.00002	1	18	0.4

Source	Type	SO_2 (g/s)	Center of volume (m)	σ_y (m)	σ_z (m)
C0053	VOLUME	0.00002	1	20	0.4
C0054	VOLUME	0.00002	1	20	0.4
C0055	VOLUME	0.00002	1	20	0.4
C0056	VOLUME	0.00002	1	20	0.4
C0058	VOLUME	0.00002	1	5	0.4
C0059	VOLUME	0.00002	1	6	0.4
C0060	VOLUME	0.00002	1	14	0.4
C0062	VOLUME	0.00002	1	13	0.4
C0065	VOLUME	0.00002	1	17	0.4
C0067	VOLUME	0.00002	1	25	0.4
C0070	VOLUME	0.00002	1	14	0.4
C0071	VOLUME	0.00002	1	9	0.4
C0075	VOLUME	0.00002	1	14	0.4
C0079	VOLUME	0.00002	1	9	0.4
C0080	VOLUME	0.00002	1	9	0.4
C0082	VOLUME	0.000009	1	20	0.4
C0083	VOLUME	0.000006	1	35	0.4
C0084	VOLUME	0.000006	1	35	0.4
C0085	VOLUME	0.000006	1	35	0.4

Natural gas compressors

Pollutant(s): NO_2

Terrain: Yes

Meteorology: Austin, TX (1983-84; 1986-88)

Ozone: NEOKN

Scenarios:

1. Base
2. Less controls for 3 of 4 stations and stack height increase #2 (NOx 2 and stack ht 3)
3. Stack height increase #1 (Stack ht 2)
4. Stack height increase #2 (Stack ht 3)
5. Less controls for 3 of 4 stations and base stack heights (NOx 3 and stack ht 1)

All scenarios modeled with 0.1 NO_2/NOx in-stack ratio and PVMRM

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	NOx 2 (g/s)	Stack ht 2 (m)	Stack ht 3 (m)	NOx 3 (g/s)
F1C001	POINT	0.1	8	900	39	0.4	2.8	35	17	2.8
F1C002	POINT	0.1	8	900	39	0.4	2.8	35	17	2.8
F1C003	POINT	0.1	8	900	39	0.4	2.8	35	17	2.8
F1C004	POINT	0.1	8	900	39	0.4	2.8	35	17	2.8
F1C005	POINT	0.1	8	900	39	0.4	2.8	35	17	2.8
F1C006	POINT	0.01	4	800	3	1	0.01	4	4	0.01
F1C007	POINT	0.01	4	500	5	0.3	0.01	4	4	0.01
F1C008	POINT	0.01	4	500	5	0.3	0.01	4	4	0.01
F1C009	POINT	0.03	9	1000	9	0.7	0.03	9	9	0.03
F2C001	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C002	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C003	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C004	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C005	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C006	POINT	1	8	900	31	0.4	2.8	35	17	2.8
F2C007	POINT	0.4	8	900	31	0.4	2.8	35	17	2.8
F2C008	POINT	0.4	8	900	31	0.4	2.8	35	17	2.8
F2C009	POINT	0.4	8	900	31	0.4	2.8	35	17	2.8
F2C010	POINT	0.4	8	900	31	0.4	2.8	35	17	2.8
F2C011	POINT	1	8	900	31	0.4	2.8	35	17	1
F2C012	POINT	0.1	8	800	20	0.1	0.1	35	17	0.1
F2C013	POINT	0.01	5	800	6	0.2	0.01	5	5	0.01
F2C014	POINT	0.01	5	800	6	0.2	0.01	5	5	0.01
F2C015	POINT	0.01	5	800	6	0.2	0.01	5	5	0.01
F2C016	POINT	0.01	5	800	6	0.2	0.01	5	5	0.01
F3C001	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2
F3C002	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2

Source	Type	NOx (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	NOx 2 (g/s)	Stack ht 2 (m)	Stack ht 3 (m)	NOx 3 (g/s)
F3C003	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2
F3C004	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2
F3C005	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2
F3C006	POINT	0.4	11	700	34	0.5	5.2	35	17	5.2
F3C007	POINT	0.4	12	700	34	0.5	5.2	35	17	5.2
F3C008	POINT	0.4	12	700	34	0.5	5.2	35	17	5.2
F3C009	POINT	0.3	12	700	34	0.5	5.9	35	17	5.9
F3C010	POINT	0.3	12	700	34	0.5	5.9	35	17	5.9
F3C011	POINT	0.3	12	700	43	0.5	7.9	35	17	7.9
F3C012	POINT	0.3	12	700	43	0.5	7.9	35	17	7.9
F3C013	POINT	0.01	3	500	3	0.3	0.01	3	3	0.01
F3C014	POINT	0.01	3	500	3	0.3	0.01	3	3	0.01
F3C015	POINT	0.01	3	500	3	0.3	0.01	3	3	0.01
F3C016	POINT	0.003	3	500	3	0.3	0.003	3	3	0.003
F4C001	POINT	0.4	11	700	44	0.5	0.4	35	17	0.4
F4C002	POINT	0.3	12	700	34	0.5	0.3	35	17	0.3
F4C003	POINT	0.3	12	700	34	0.5	0.3	35	17	0.3
F4C004	POINT	0.5	14	700	45	0.5	0.5	35	14	0.5
F4C005	POINT	0.5	14	700	45	0.5	0.5	35	14	0.5
F4C006	POINT	0.5	14	700	45	0.5	0.5	35	14	0.5
F4C007	POINT	0.5	14	700	45	0.5	0.5	35	14	0.5
F4C008	POINT	0.3	14	700	45	0.5	0.3	35	14	0.3
F4C009	POINT	0.3	14	700	45	0.5	0.3	35	14	0.3
F4C010	POINT	0.3	14	700	34	0.5	0.3	35	14	0.3
F4C011	POINT	0.3	14	700	34	0.5	0.3	35	14	0.3
F4C012	POINT	0.003	3	500	4	0.3	0.003	3	3	0.003
F4C013	POINT	0.01	3	500	5	0.3	0.01	3	3	0.01

Cement kiln

Pollutant(s): NO_2, SO_2

Terrain: Yes

Meteorology: Charleston, SC (2002-06)

Ozone: Spartanburg, SC (2002-06)

Scenarios (both pollutants):

1. Base
2. Controls (NOx 2 and SO_2 2)
3. Additional controls (NOx 3 and SO_2 3)

NO2 base scenario modeled with PVMRM and:

1. Comparison of NO_2/NOx in-stack ratios of 0.05, 0.1, 0.25, and 0.5
2. Comparison of ozone concentrations of 40 and 80 ppb with NO2/NOx ratio of 0.1

Scenario 2 modeled with NO_2/NOx in-stack ratios of 0.05 and 0.1

Scenario 3 modeled with NO_2/NOx ratios of 0.05, 0.1, 0.25, and 0.5

Source	Type	NOx (g/s)	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	NOx 1 (g/s)	NOx 2 (g/s)	SO_2 2 (g/s)	SO_2 3 (g/s)
C0001	POINT	190	75	160	375	16	6	57	25	25	8
C0002	POINT	15	15	160	360	12	2.5	5	2	5	2
C0003	POINT	0.2	0	90	375	17	2	0.2	0.2		
C0004	POINT	0.2	0	90	375	17	2	0.2	0.2		

Landfill gas turbine

Pollutant(s): NO_2, SO_2

Terrain: Yes

Meteorology: Pease AFB, NH (2000-04)

Ozone: 40 ppb

Scenarios (both pollutants):

1. Base
2. Stack height increase #1 (Stack ht 2)
3. Stack height increase #2 (Stack ht 3)

For NO_2, comparisons were made for PVMRM with NO_2/NOx in-stack ratios of 0.05 and 0.1 for all scenarios

Source	Type	NOx (g/s)	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)
C0001	POINT	0.6	0.4	13	600	27	1.3	35	65
C0002	POINT	0.6	0.4	13	600	27	1.3	35	65
C0003	POINT	0.6	0.4	13	600	27	1.3	35	65
C0004	POINT	0.5	0.1	10	700	3.5	1.5	30	65

Fuel oil turbine

Pollutant(s): NO_2, SO_2

Terrain: Yes

Meteorology: Bristol, TN (2004-08)

Ozone: 60 ppb and Sullivan County, TN (2004-08)

Scenarios NO_2:

1. Base
2. Stack height increase #1 (Stack ht 2)
3. Stack height increase #2 (Stack ht 3)
4. Scenario 3 heights with increased emissions (NOx 2 and Stack ht 3)

All NO_2 scenarios also compared:

1. OLM with 60 ppb ozone concentrations with NO_2/NOx in-stack ratios of 0.05 and 0.1
2. PVMRM with 60 ppb ozone concentrations with NO_2/NOx in-stack ratios of 0.05 and 0.1
3. PVMRM with actual ozone concentrations with NO_2/NOx in-stack ratios of 0.05 and 0.1

SO_2 scenarios:

1. Base
2. Stack height increase #1 (Stack ht 2)

3. Stack height increase #2 (Stack ht 3)

Source	Type	NOx (g/s)	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	NOx 2 (g/s)
C0001	POINT	10	4	25	700	25	4	45	65	20
C0002	POINT	10	4	25	700	25	4	45	65	20
C0003	POINT	10	4	25	700	25	4	45	65	20
C0004	POINT	1	0	25	400	12	3	45	45	1
C0005	POINT	1	0	25	400	12	3	45	45	1
C0006	POINT	1	0	25	400	12	3	45	45	1
C0007	POINT	1	0	25	400	12	3	45	45	1
H01	POINT	0.02	0	6	700	10	0.2	6	6	0.02
H02	POINT	0.02	0	6	700	10	0.2	6	6	0.02
H03	POINT	0.02	0	6	700	10	0.2	6	6	0.02

Pulp & paper

Pollutant(s): SO_2

Terrain: Yes

Meteorology: Mobile, AL (2001-05)

Scenarios:

1. Base
2. Increase stack height #1 (Stack ht 2)
3. Increase stack height #2 (Stack ht 3)
4. Scenario 3 stack heights and controlled emissions (SO_2 2 and Stack ht 3)

Source	Type	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	SO_2 2 (g/s)
C0001	POINT	2	30	350	13	1.3	45	65	2
C0002	POINT	8	30	340	7	1.4	45	65	8
C0003	POINT	7	29	350	7	2	45	65	7
C0004	POINT	28	85	460	12	5	120	120	8
C0005	POINT	28	85	460	12	5	120	120	8
C0006	POINT	5	72	440	17	2.5	120	120	5
C0007	POINT	5	72	440	17	2.5	120	120	5
C0008	POINT	14	76	350	12	4	120	120	3
C0009	POINT	0.5	8	483	0	0.4	8	8	0.5
C0010	POINT	0.2	67	350	9	1	67	67	0.2
C0011	POINT	0.2	67	350	9	1	67	67	0.2

Flare

Pollutant(s): SO_2

Terrain: Yes

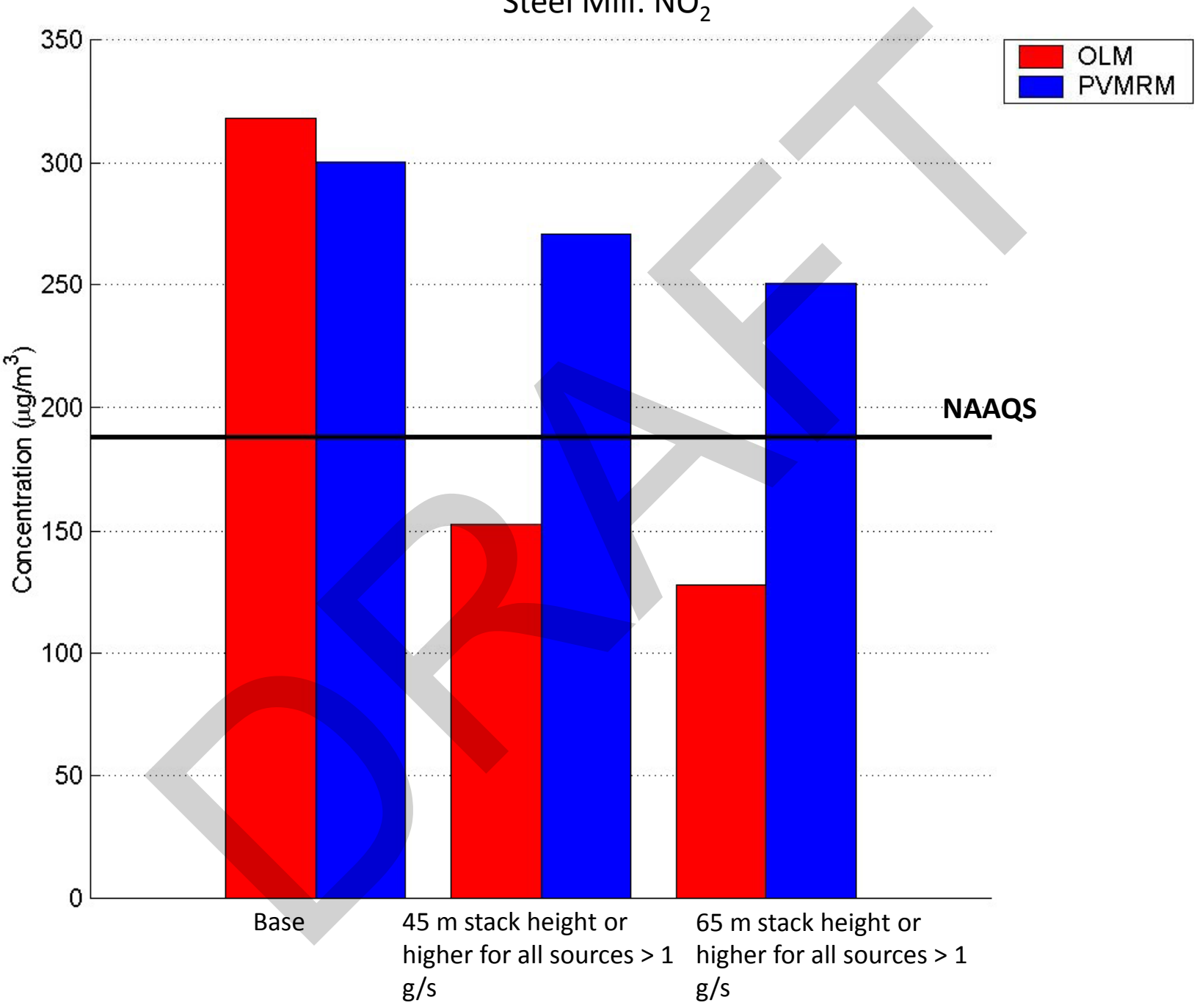
Meteorology: Poughkeepsie, NY (2006-10)

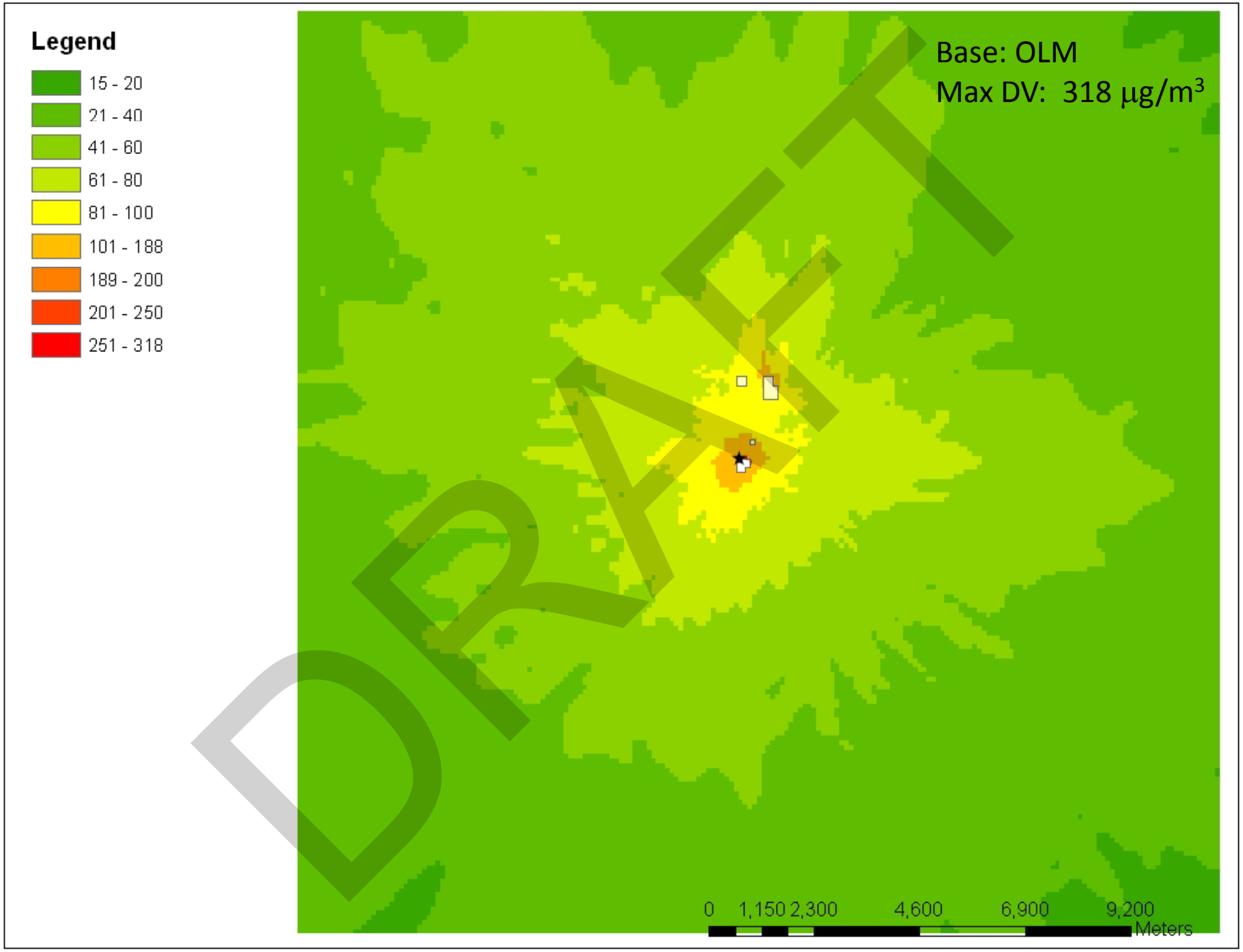
Scenarios:

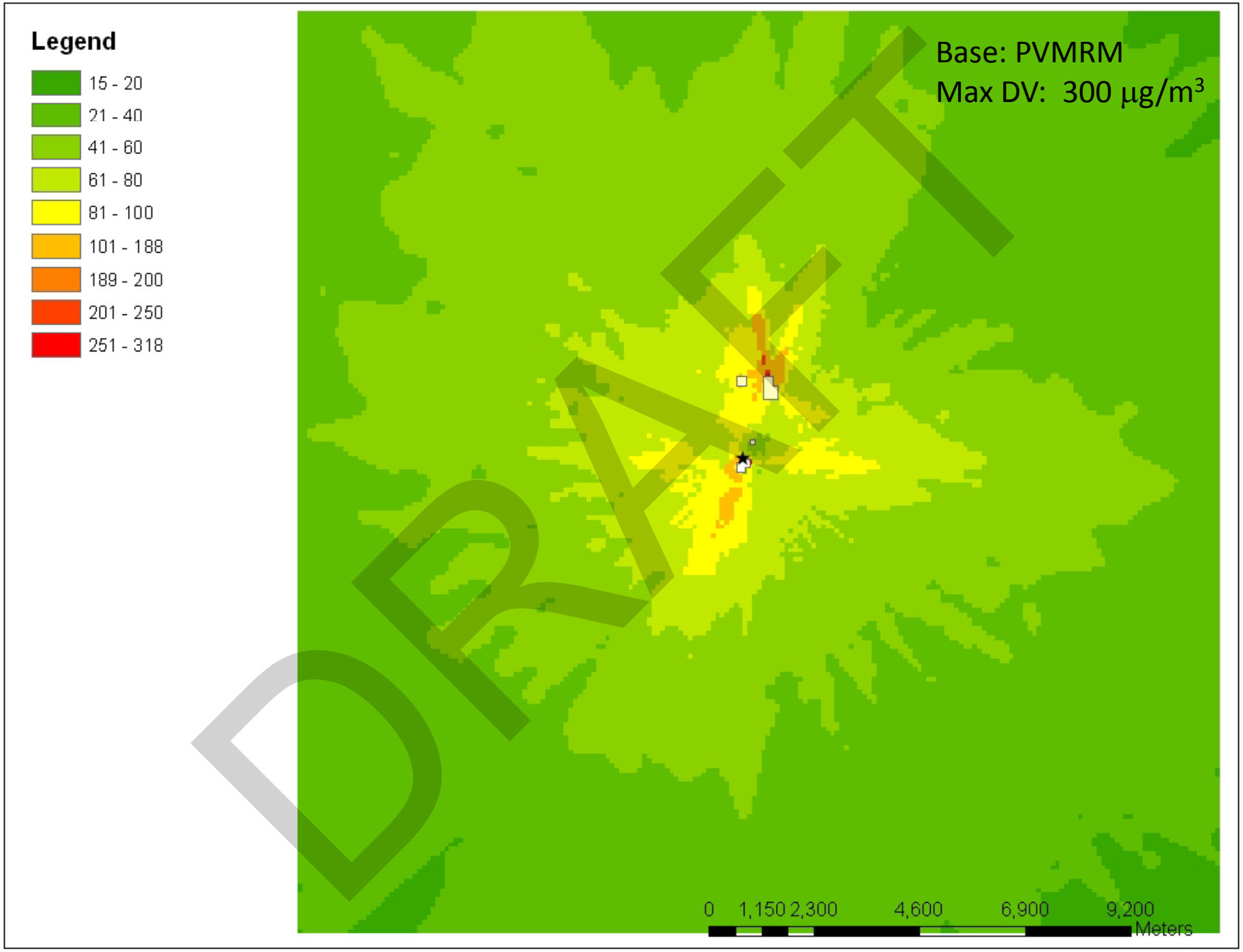
1. Base
2. Increase stack height #1 (Stack ht 2)
3. Increase stack height #2 (Stack ht 3)
4. Scenario 3 stack heights and controlled emissions (SO_2 2 and Stack ht 3)

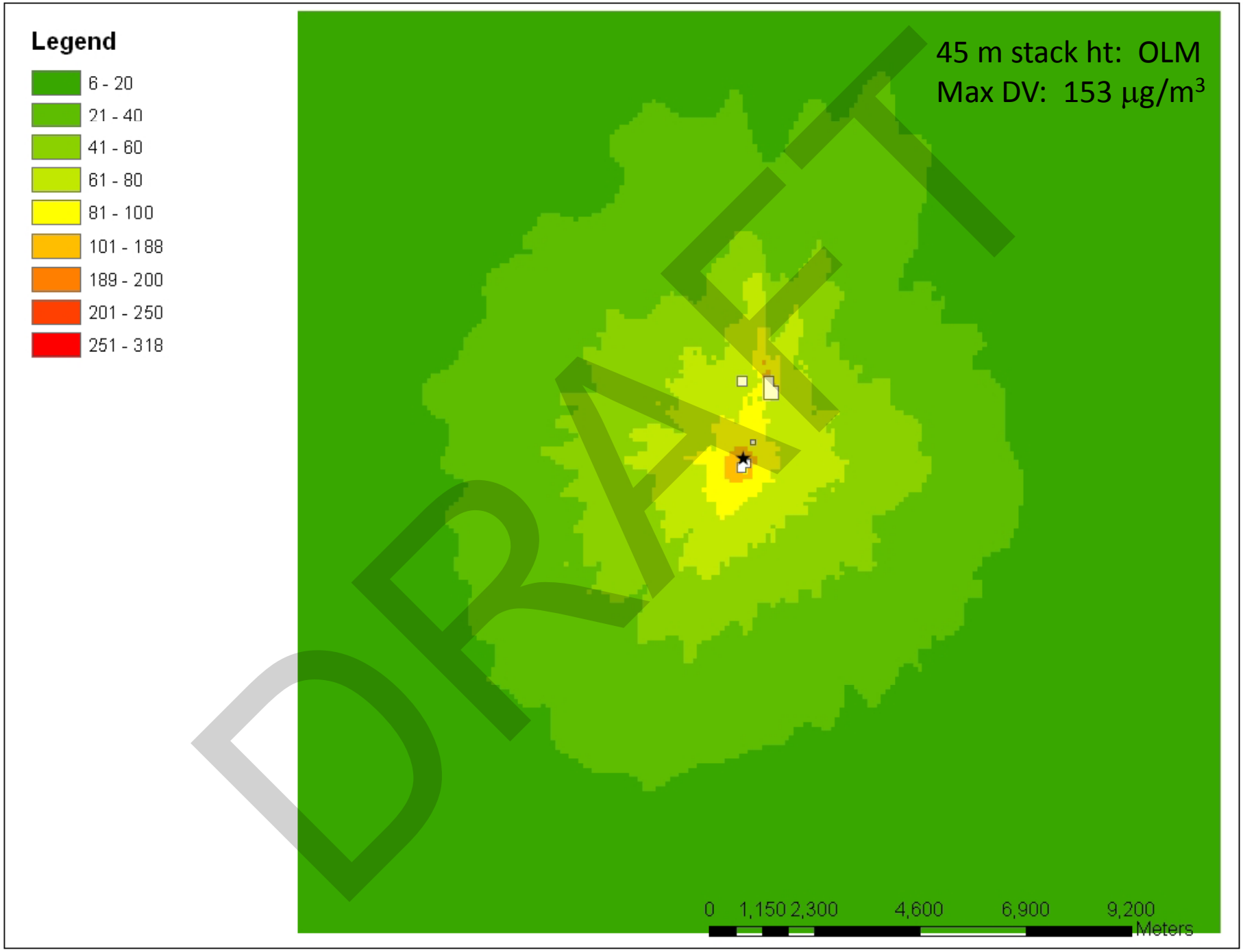
Source	Type	SO_2 (g/s)	Stack ht 1 (m)	Stack temperature (K)	Stack velocity (m/s)	Diameter (m)	Stack ht 2 (m)	Stack ht 3 (m)	SO_2 2 (g/s)
FLARE	POINT	175	25	1000	45	2.69	45	65	18

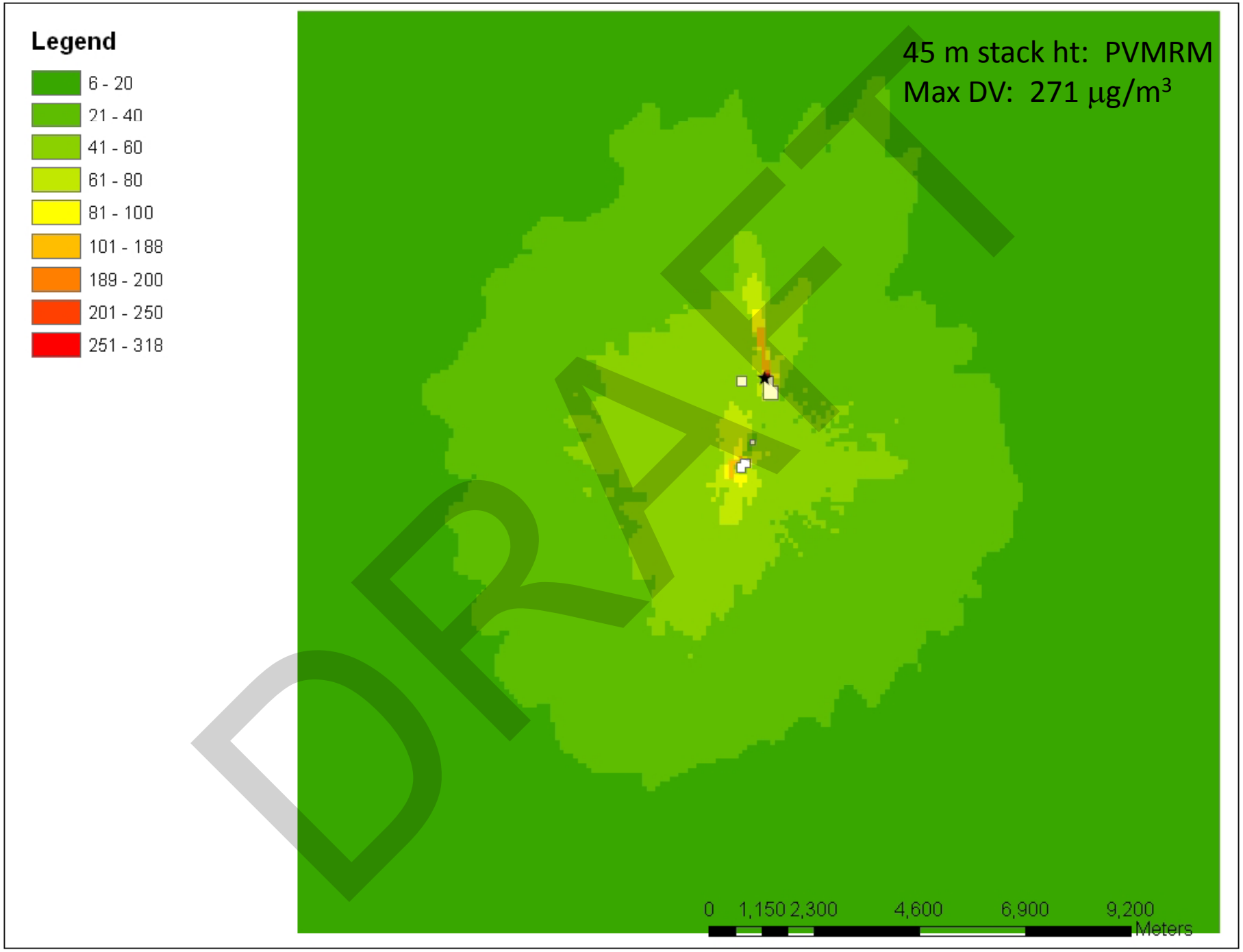
Appendix B: AIWG Phase 1 Results
Single Source Case Studies

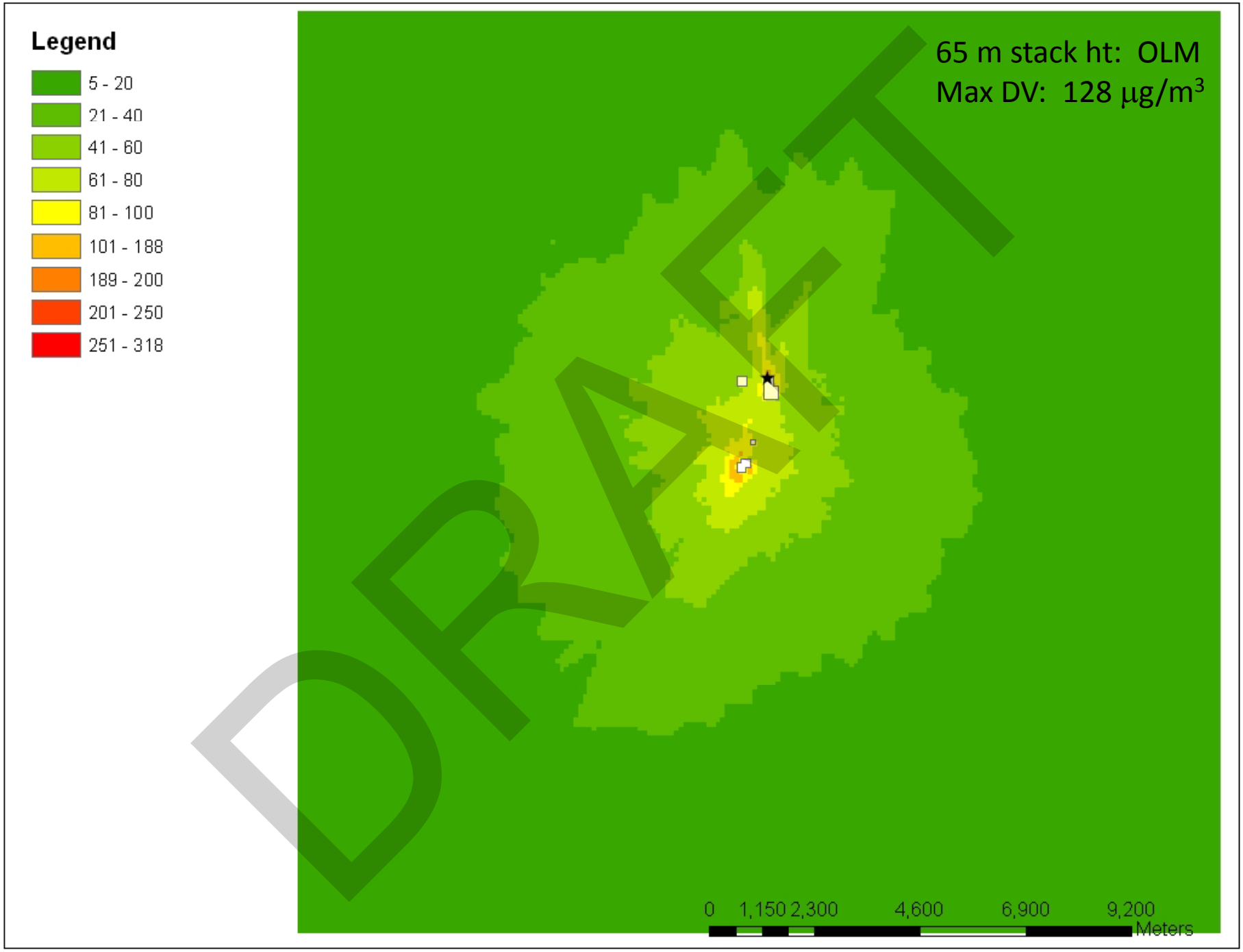

Steel Mill: NO_2
OLM
PVMRM
Concentration ($\mu g/m^3$)
350
300
250
200
150
100
50
0
NAAQS
Base
45 m stack height or higher for all sources > 1 g/s
65 m stack height or higher for all sources > 1 g/s


Legend
15 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
Base: OLM
Max DV: 318 µg/m3
DRAFT
0 1,150 2,300 4,600 6,900 9,200
Meters

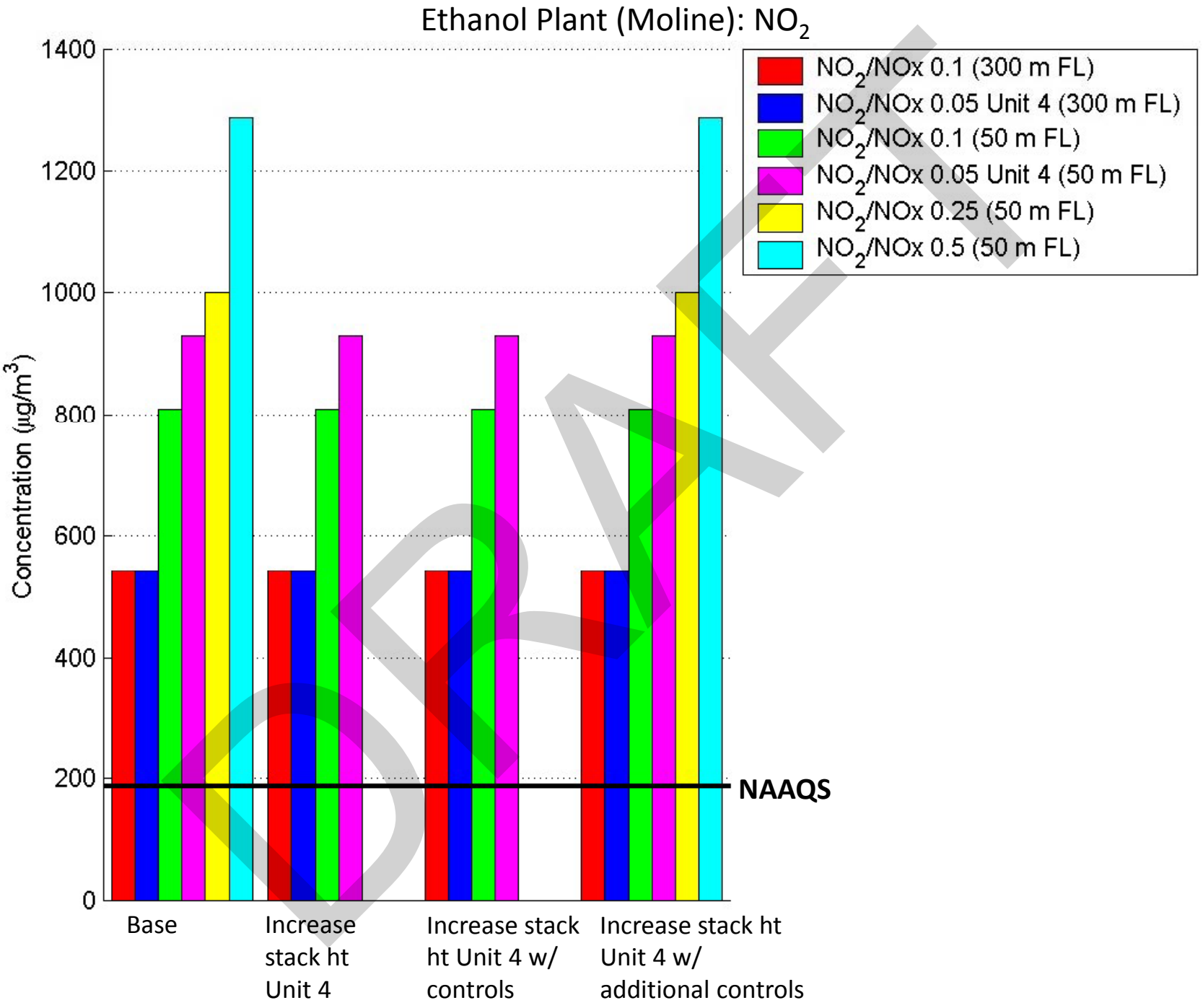

Legend
15 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
Base: PVMRM
Max DV: 300 µg/m3
0 1,150 2,300 4,600 6,900 9,200
Meters
DRAFT

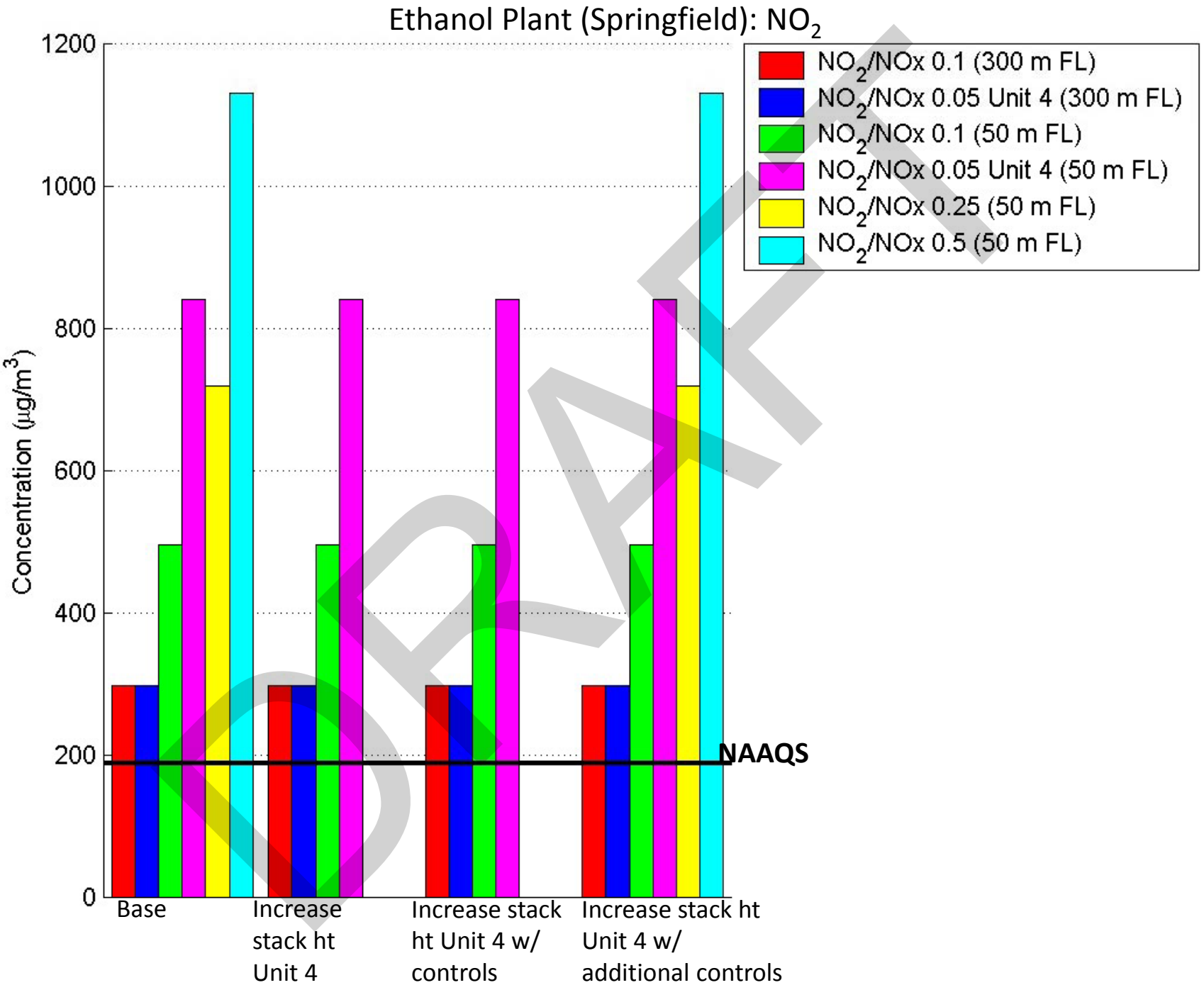

Legend
6 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
45 m stack ht: OLM
Max DV: 153 µg/m3
DRAFT
0 1,150 2,300 4,600 6,900 9,200
Meters


Legend
6 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
45 m stack ht: PVMRM
Max DV: 271 µg/m3
0 1,150 2,300 4,600 6,900 9,200
Meters
DRAFT

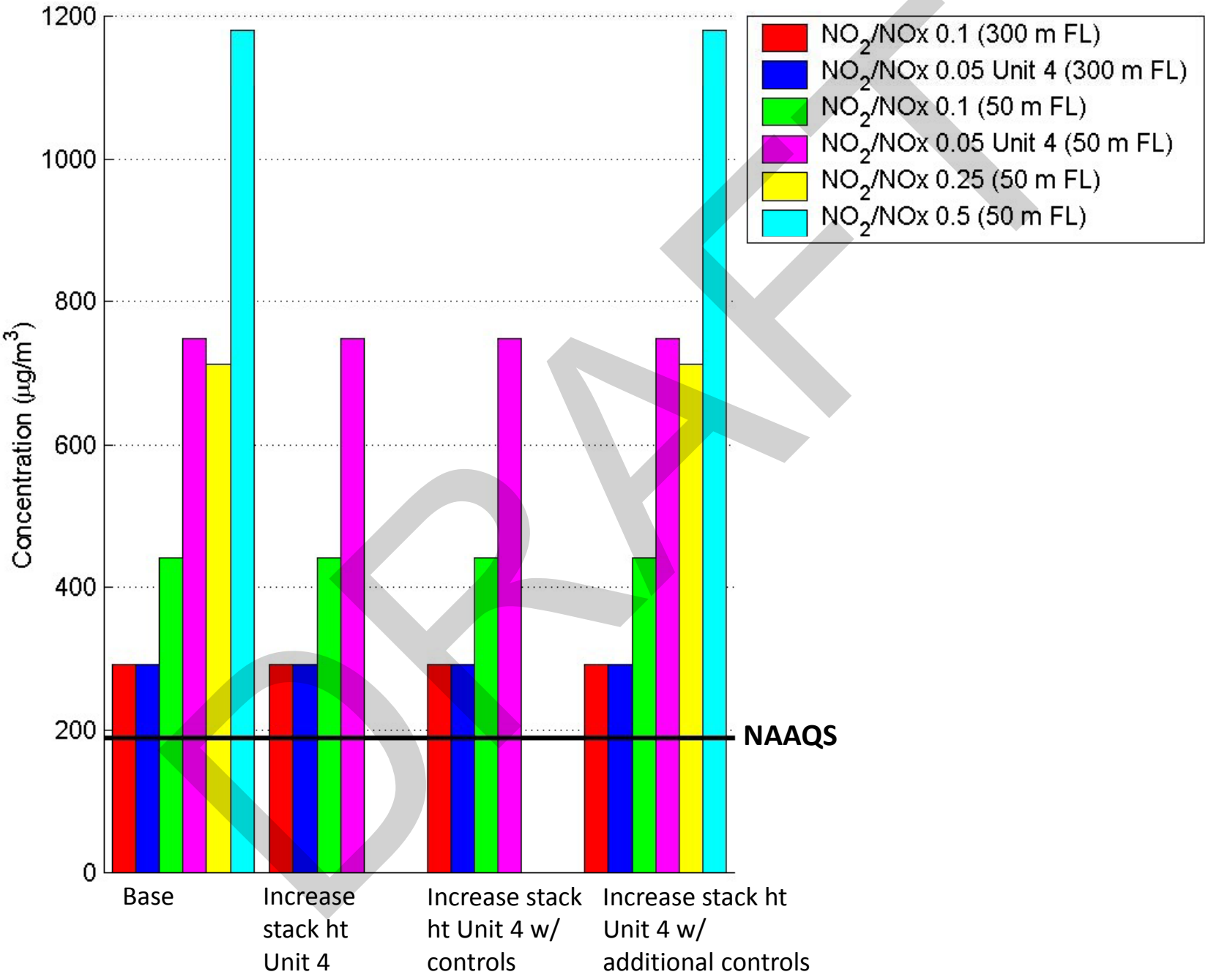

Legend
5 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
65 m stack ht: OLM
Max DV: 128 µg/m3
DRAFT
0 1,150 2,300 4,600 6,900 9,200
Meters


Legend
5 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 188
189 - 200
201 - 250
251 - 318
65 m stack ht: PVMRM
Max DV: 250 µg/m3
0 1,150 2,300 4,600 6,900 9,200
Meters
DRAFT

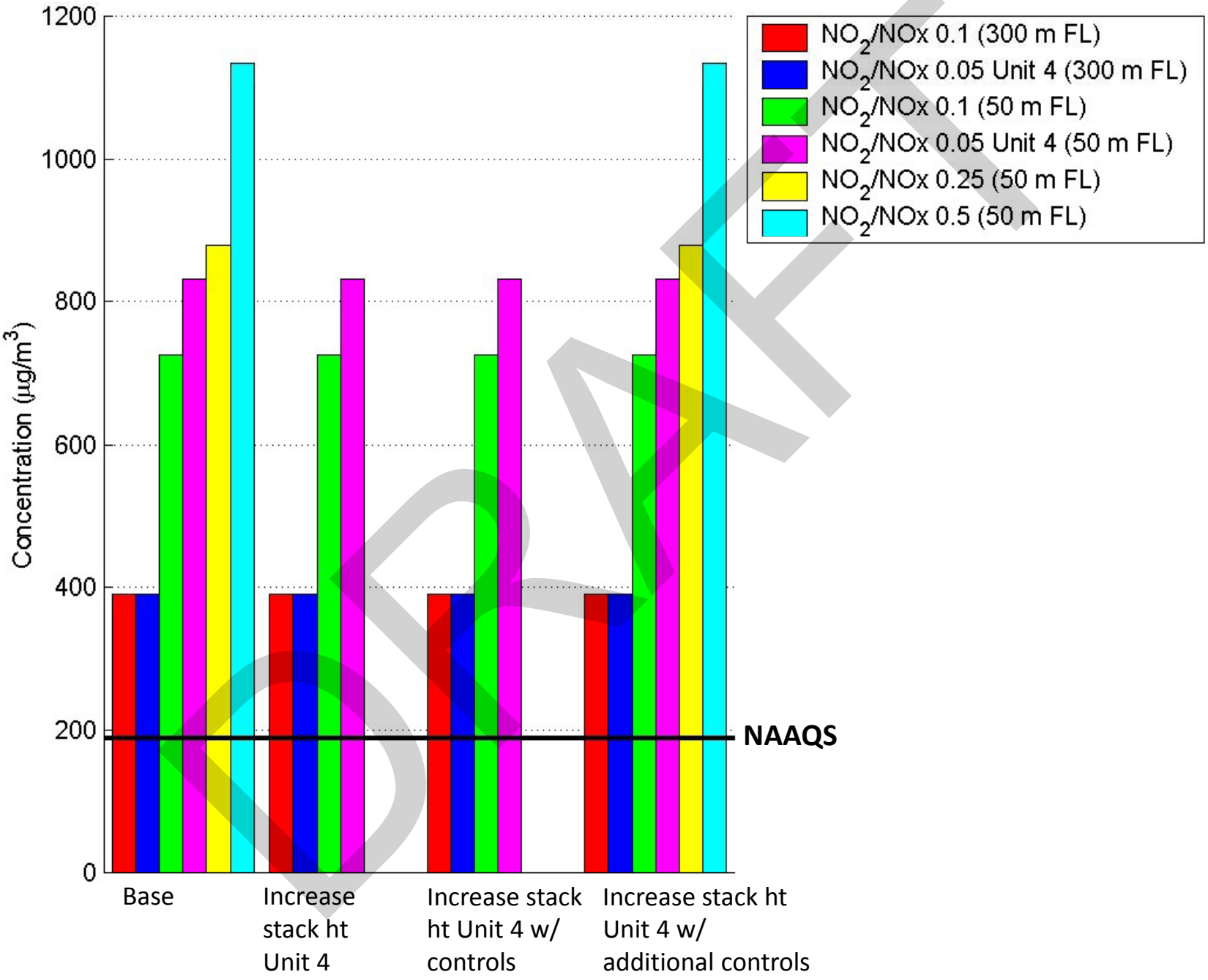

Ethanol Plant (Moline): NO2
NO2/NOx 0.1 (300 m FL)
NO2/NOx 0.05 Unit 4 (300 m FL)
NO2/NOx 0.1 (50 m FL)
NO2/NOx 0.05 Unit 4 (50 m FL)
NO2/NOx 0.25 (50 m FL)
NO2/NOx 0.5 (50 m FL)
Concentration (µg/m3)
1400
1200
1000
800
600
400
200
0
NAAQS
Base
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls


Ethanol Plant (Springfield): NO2
NO2/NOx 0.1 (300 m FL)
NO2/NOx 0.05 Unit 4 (300 m FL)
NO2/NOx 0.1 (50 m FL)
NO2/NOx 0.05 Unit 4 (50 m FL)
NO2/NOx 0.25 (50 m FL)
NO2/NOx 0.5 (50 m FL)
Concentration (µg/m3)
1200
1000
800
600
400
200
0
NAAQS
Base
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls

Ethanol Plant (St. Louis): NO_2



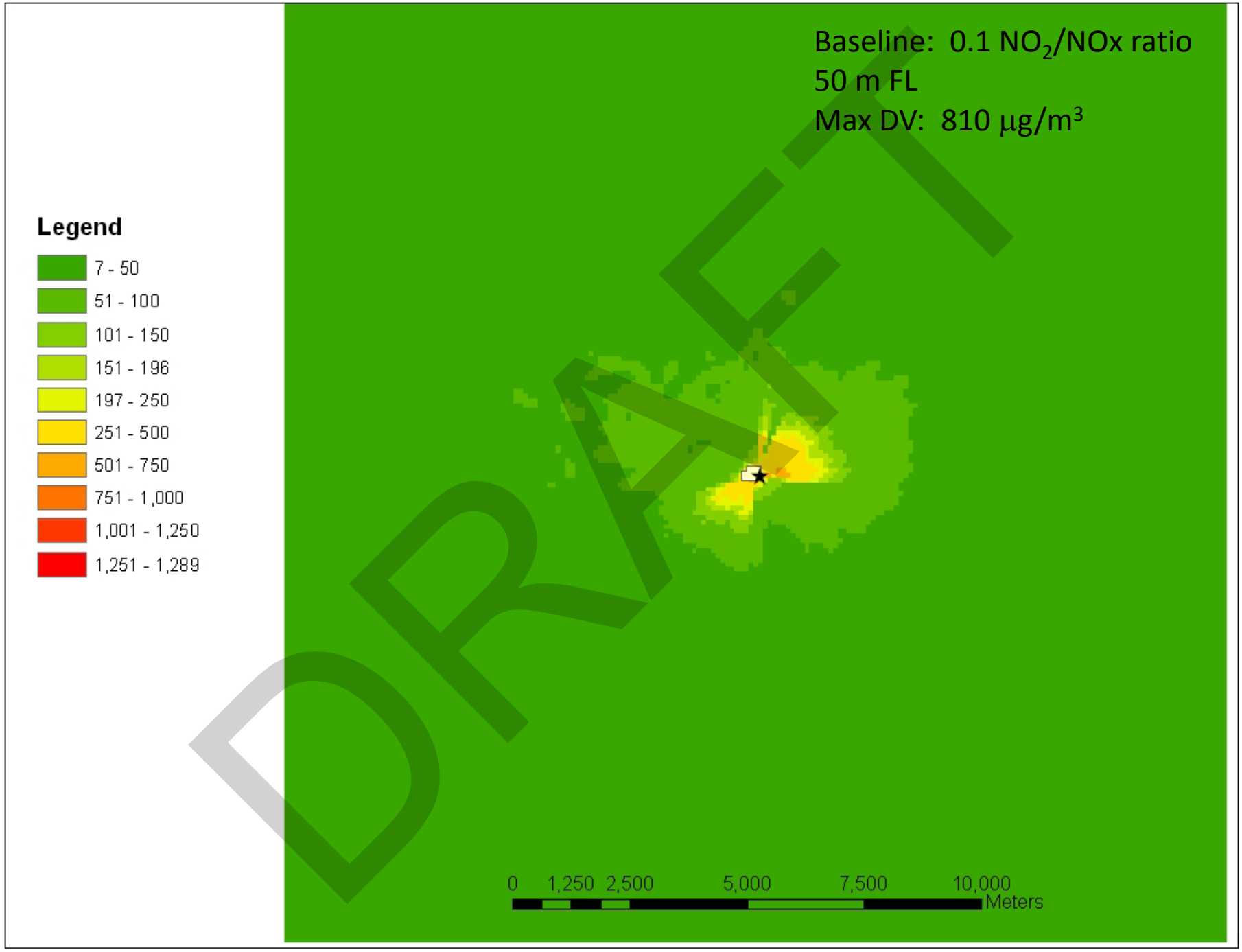
Ethanol Plant (Waterloo): NO_2

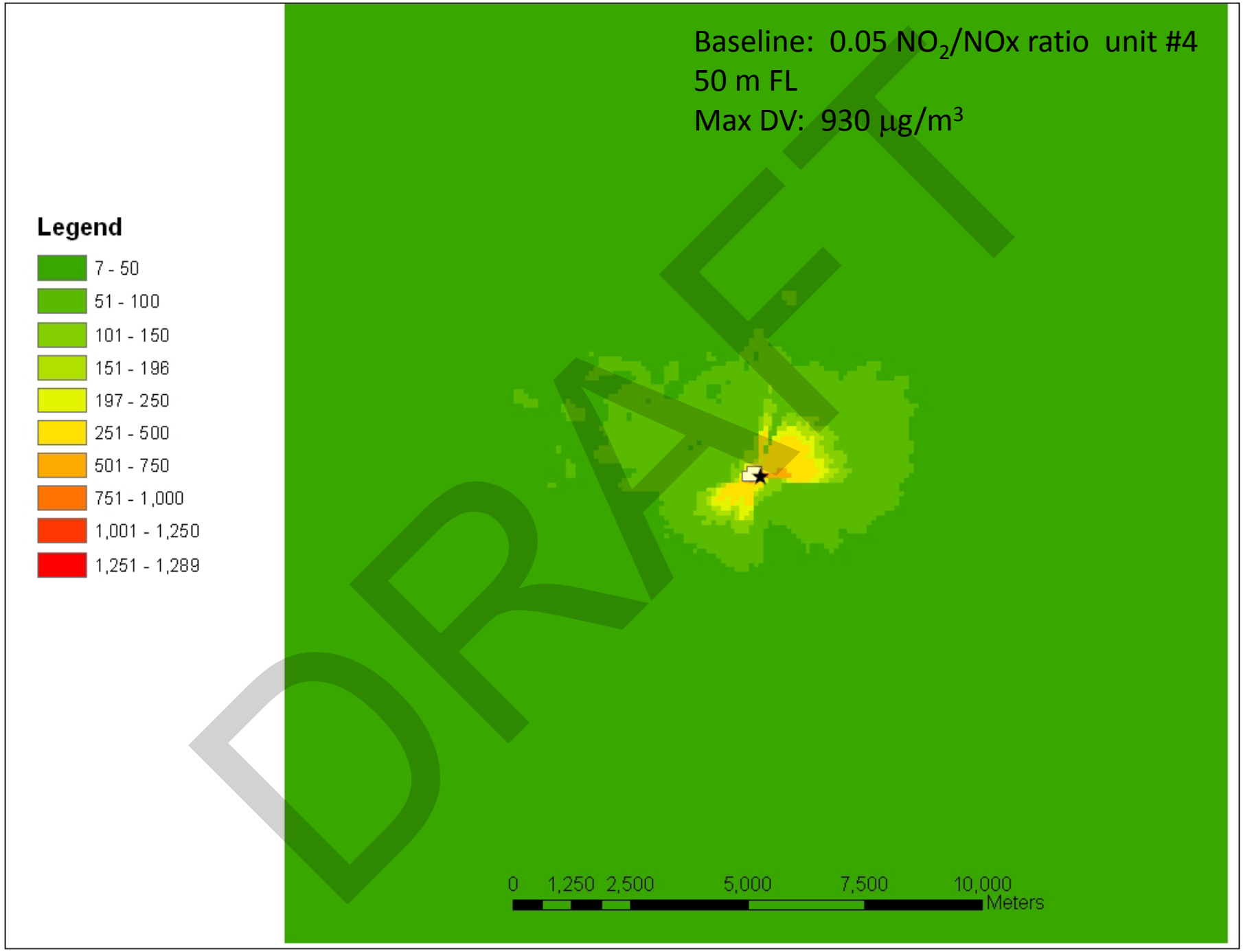


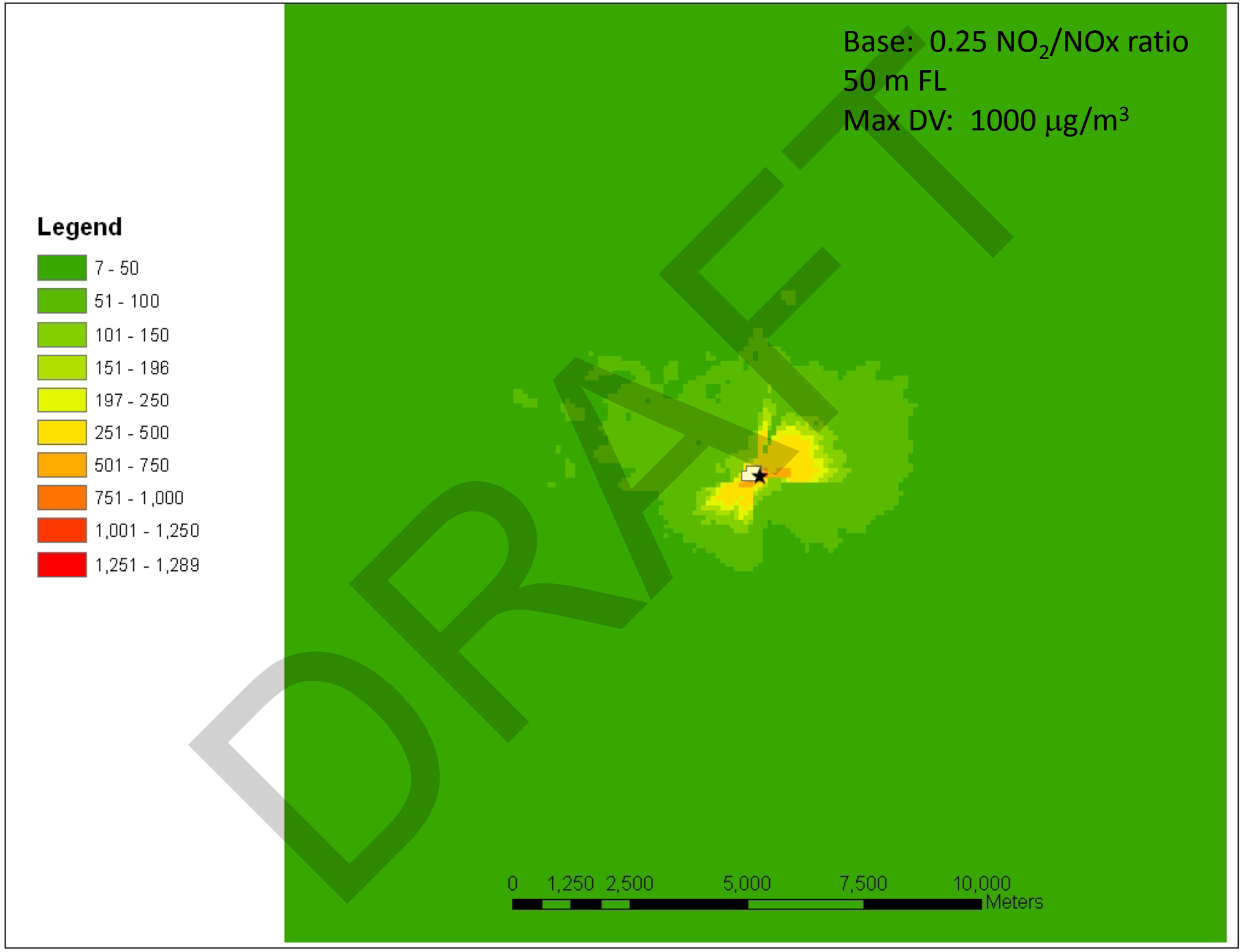
Contour plots for Moline

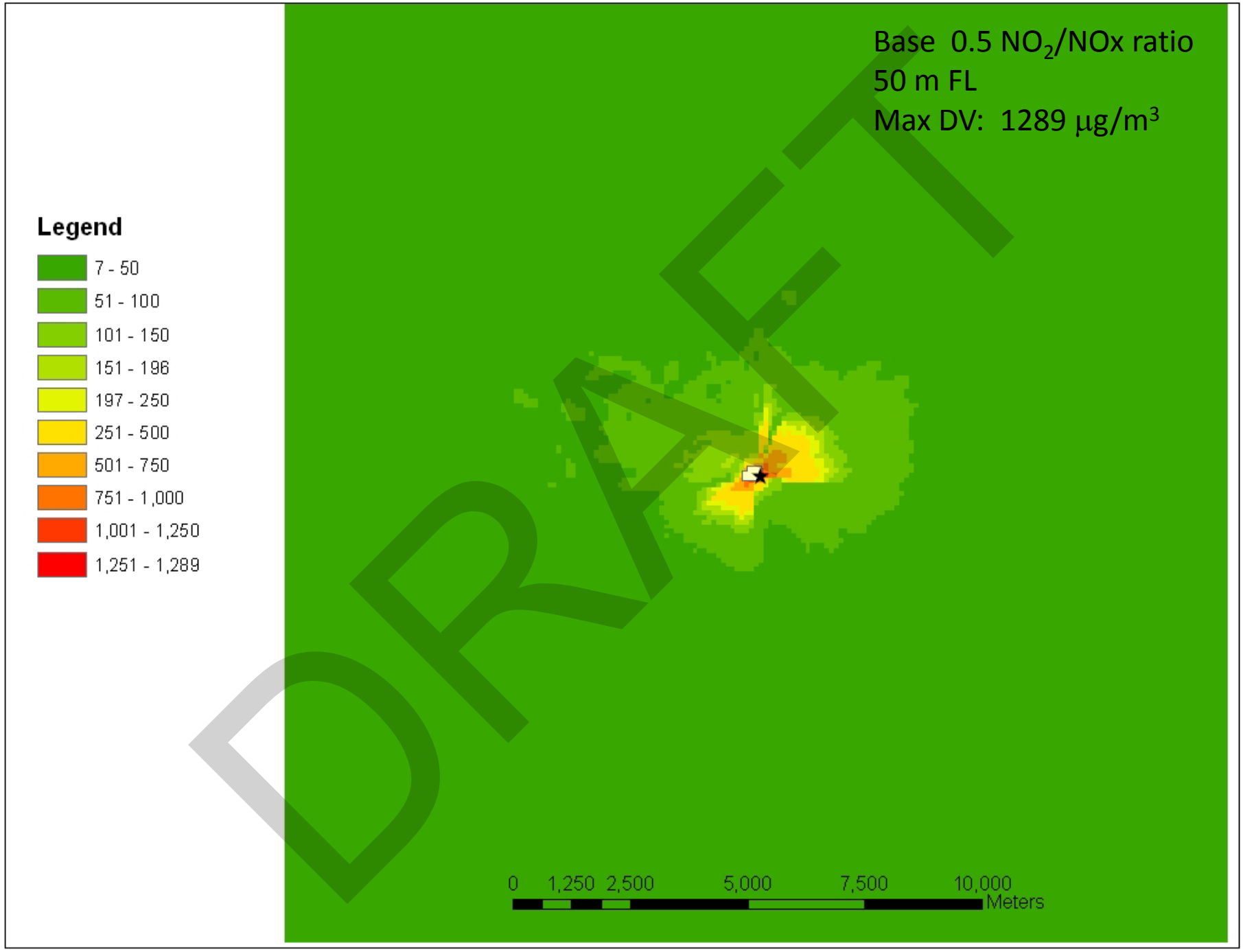

Base: 0.1 NO_2/NOx ratio
300 m FL
Max DV: 543 µg/m³
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Base 0.05 NO_2/NOx ratio unit #4
300 m FL
Max DV: 543 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

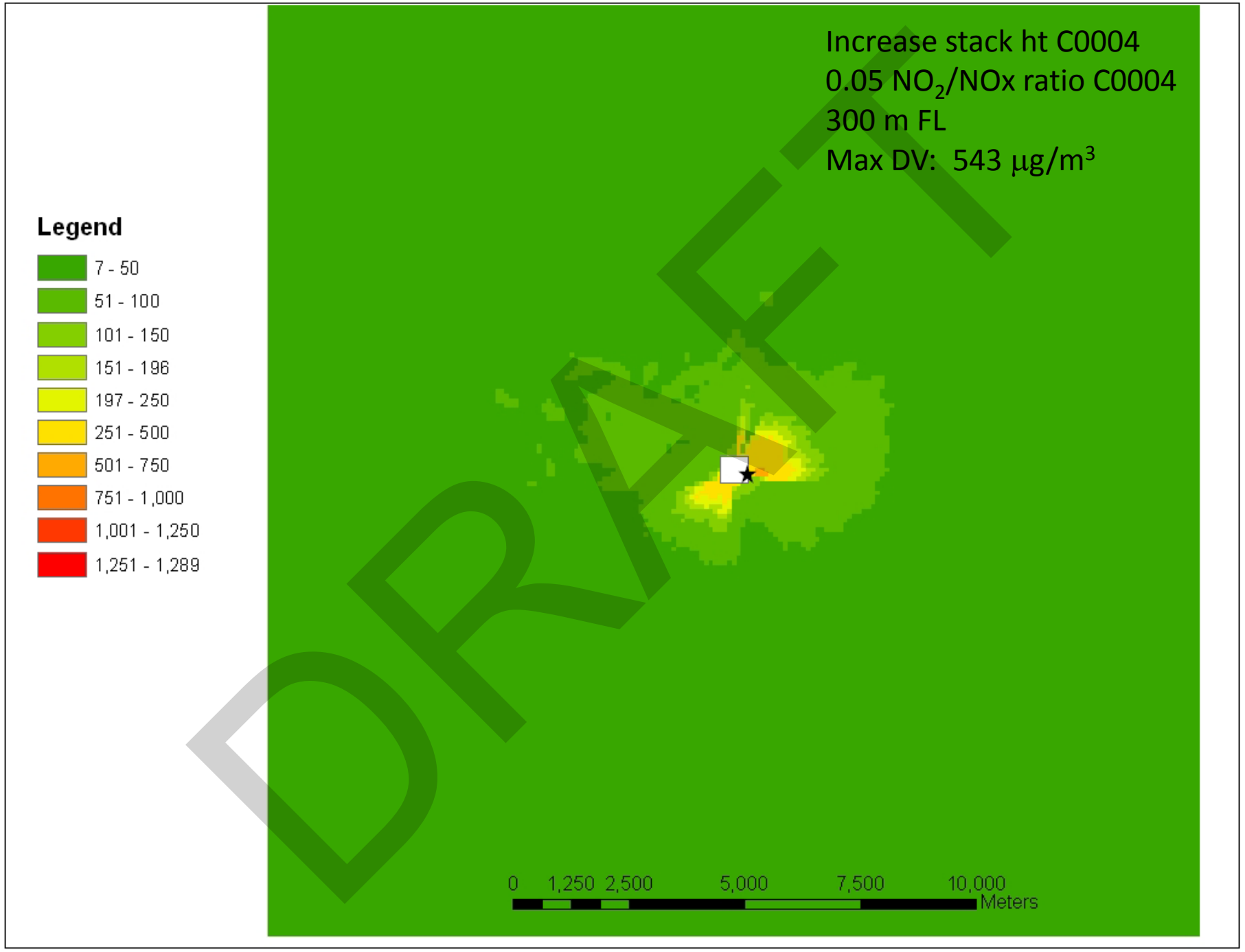

Baseline: 0.1 NO2/NOx ratio
50 m FL
Max DV: 810 µg/m3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Baseline: 0.05 NO_2/NOx ratio unit #4
50 m FL
Max DV: 930 µg/m³
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

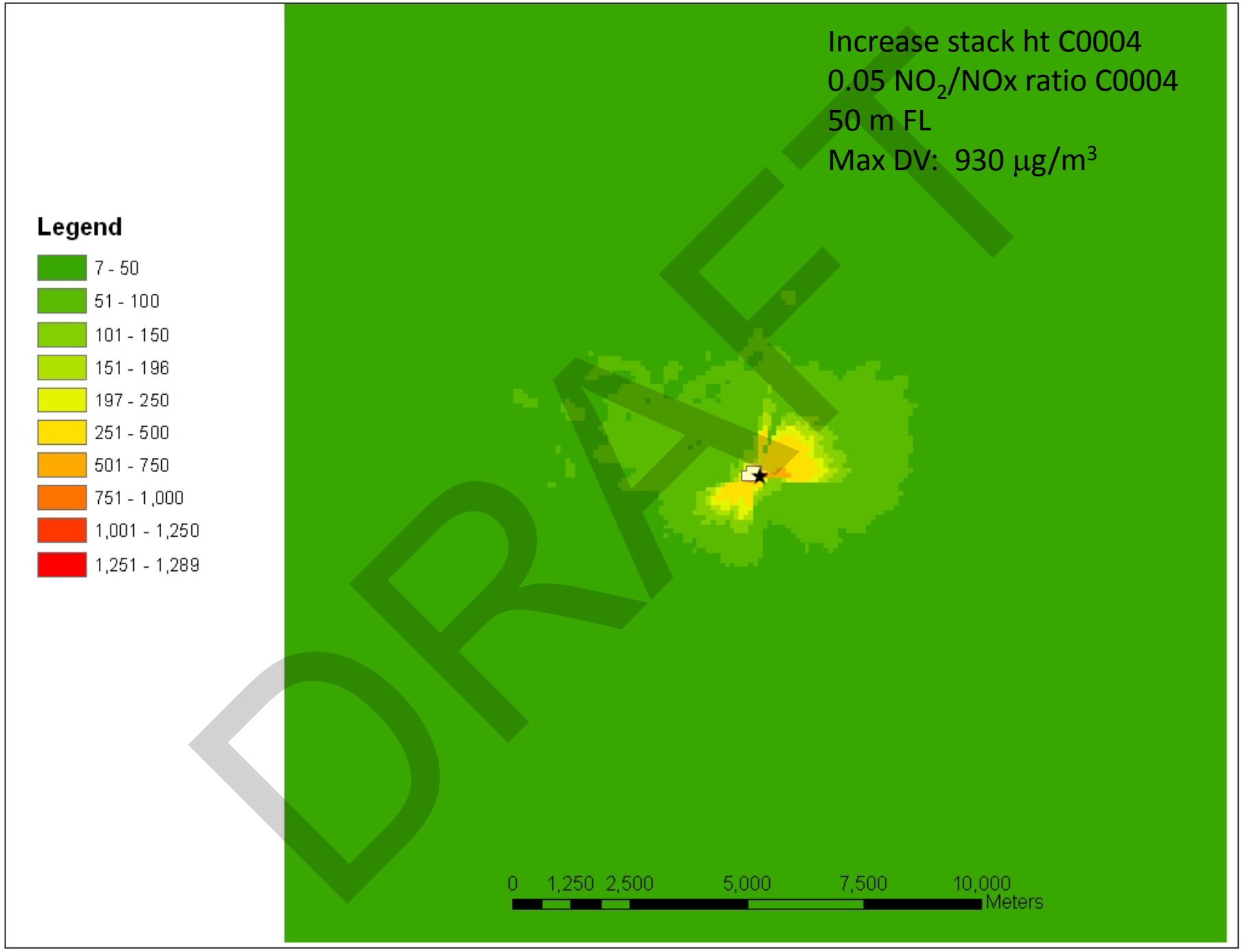

Base: 0.25 NO_2/NOx ratio
50 m FL
Max DV: 1000 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

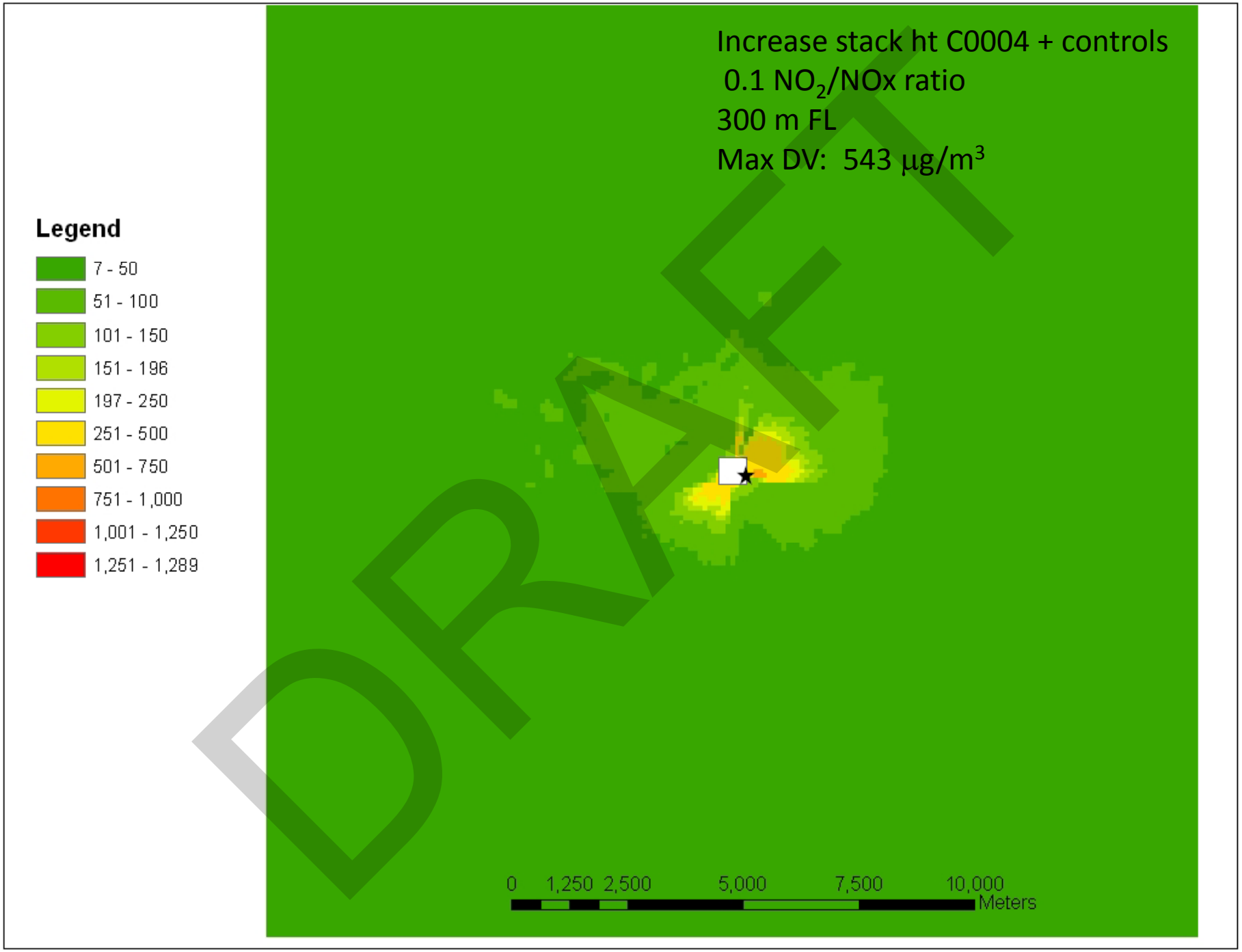

Base 0.5 NO_2/NOx ratio
50 m FL
Max DV: 1289 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Increase stack ht C0004
0.1 NO_2/NOx ratio
300 m FL
Max DV: 543 µg/m³
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

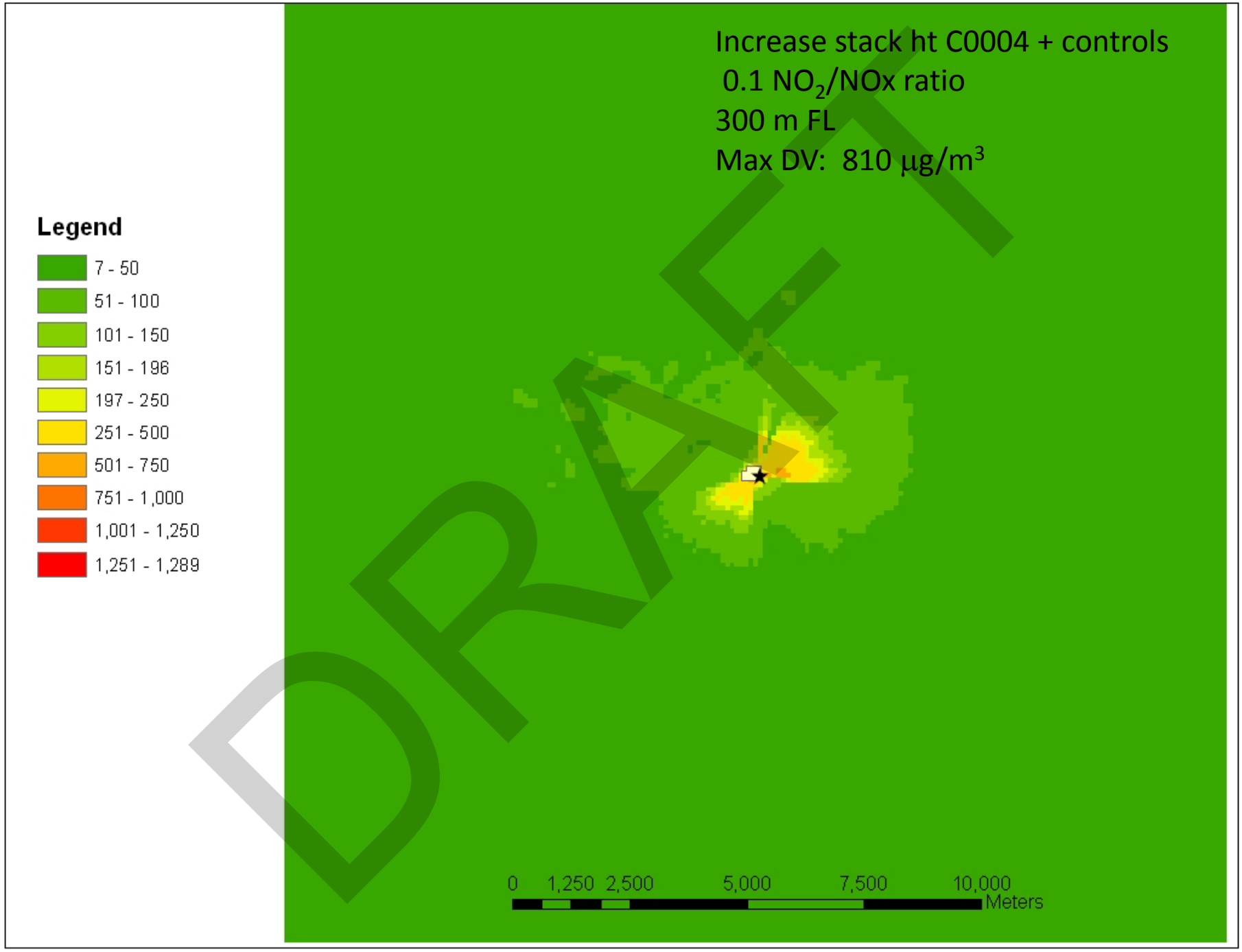

Increase stack ht C0004
0.05 NO_2/NOx ratio C0004
300 m FL
Max DV: 543 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

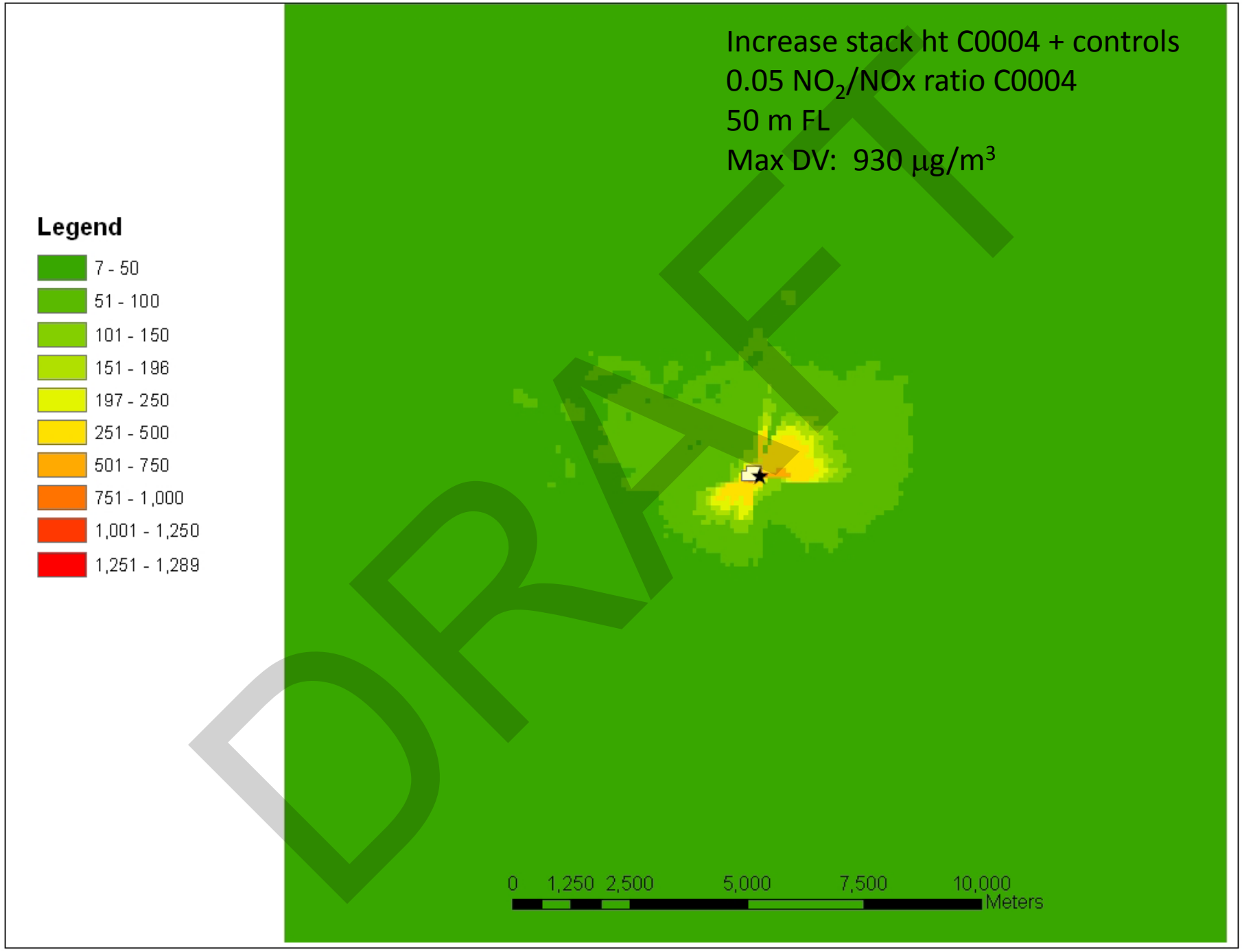

Increase stack ht C0004
0.1 NO_2/NOx ratio
50 m FL
Max DV: 810 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

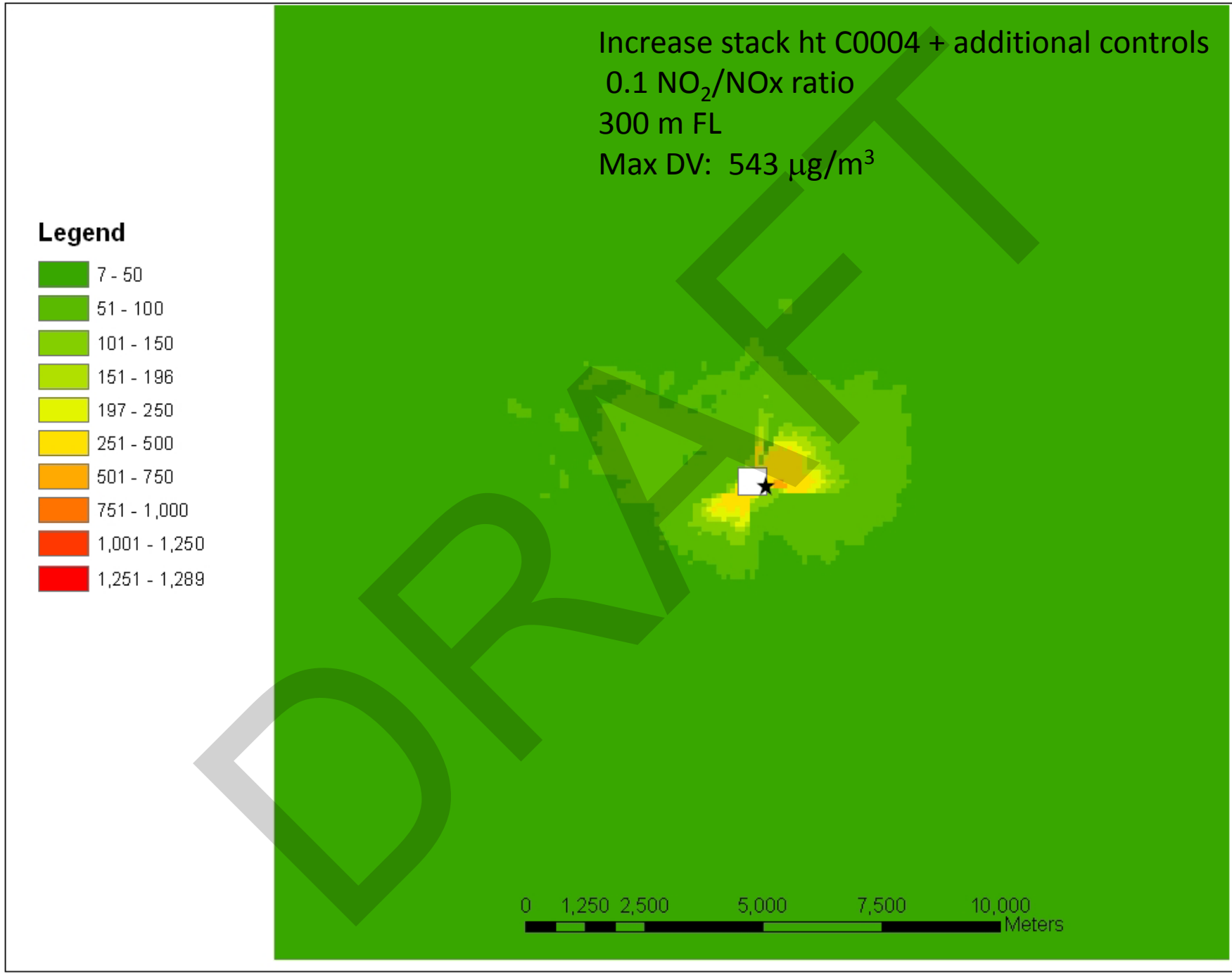

Increase stack ht C0004
0.05 NO_2/NOx ratio C0004
50 m FL
Max DV: 930 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

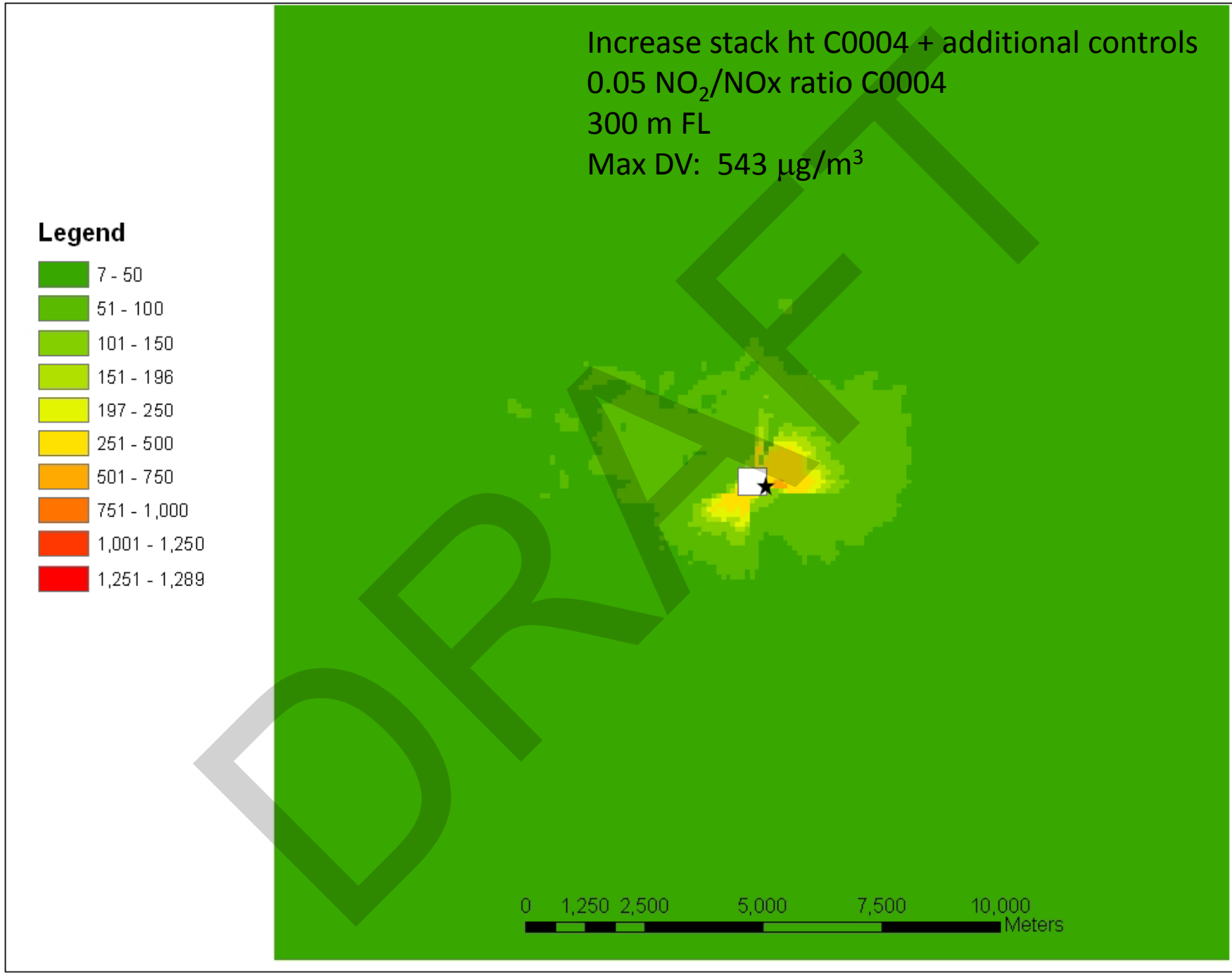

Increase stack ht C0004 + controls
0.1 NO2/NOx ratio
300 m FL
Max DV: 543 µg/m3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

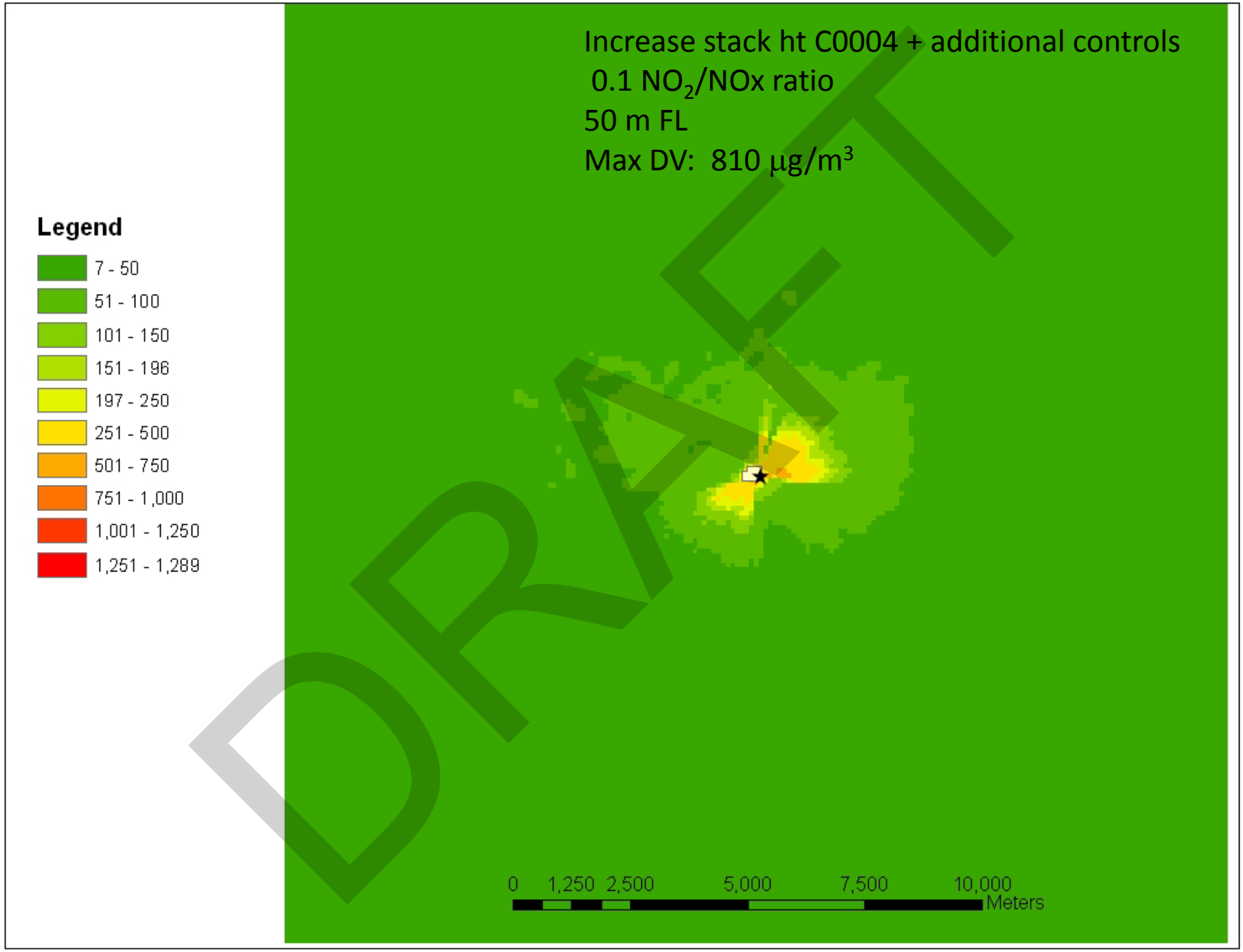

Increase stack ht C0004 + controls
0.05 NO2/NOx ratio C0004
300 m FL
Max DV: 543 µg/m3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

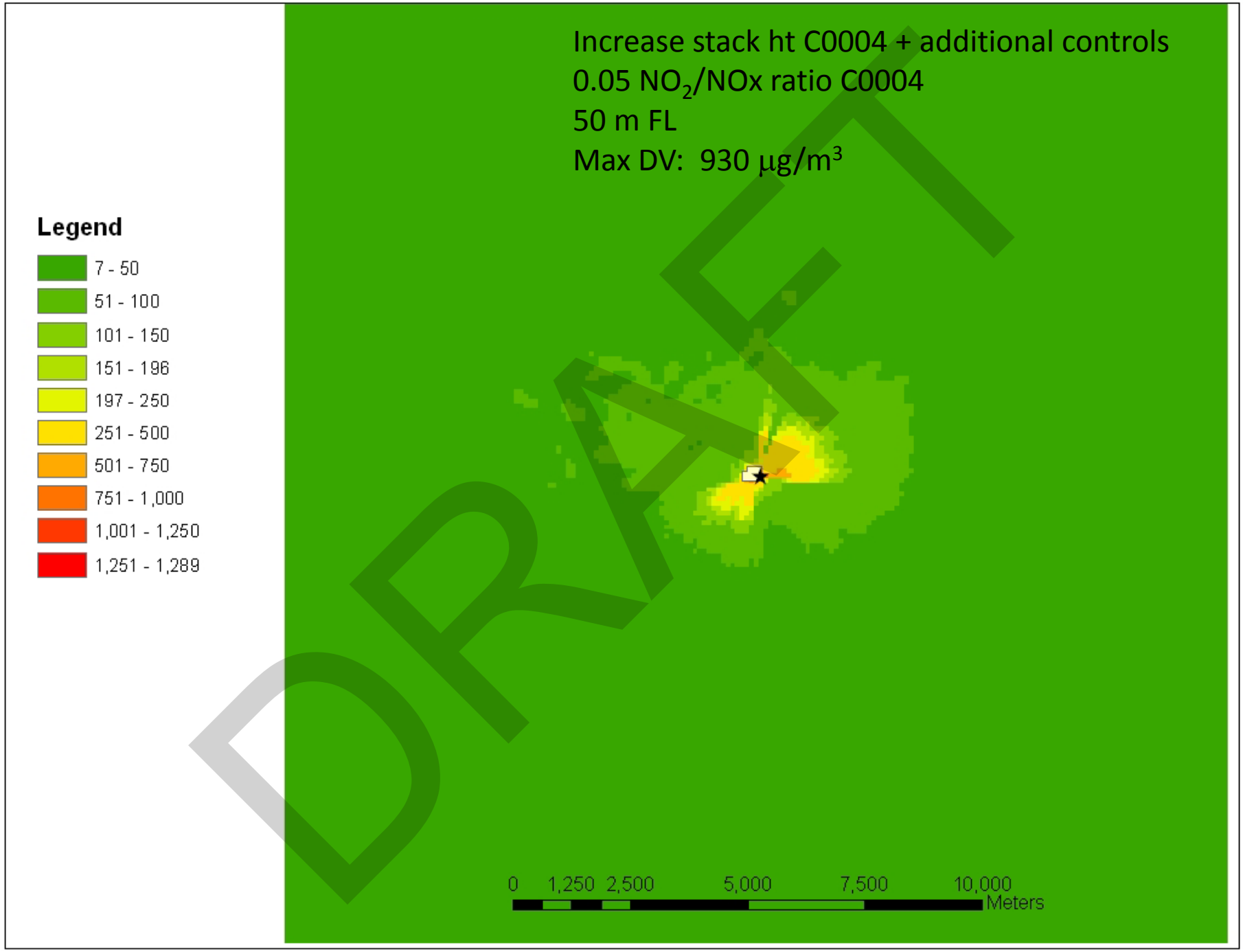

Increase stack ht C0004 + controls
0.1 NO2/NOx ratio
300 m FL
Max DV: 810 µg/m3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

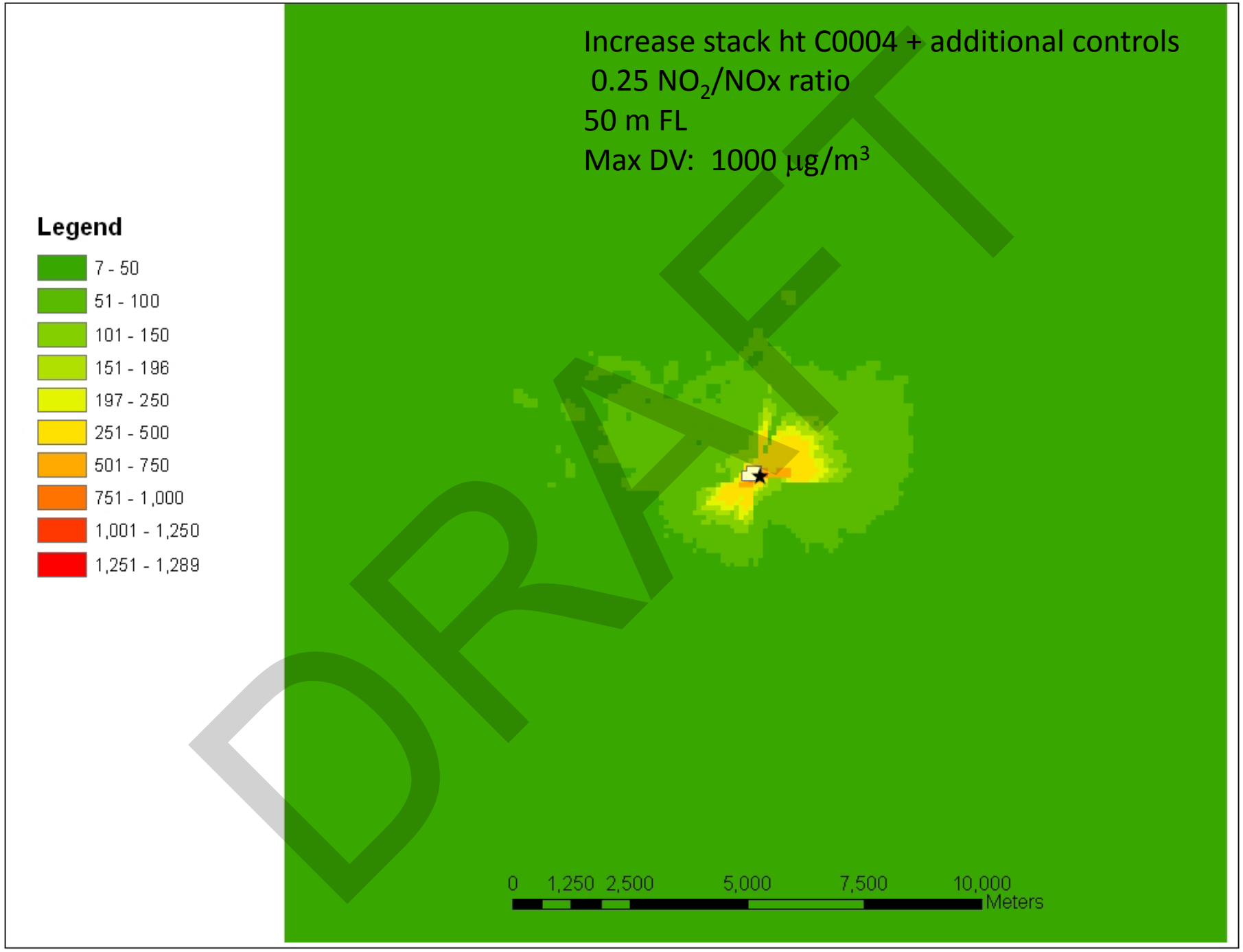

Increase stack ht C0004 + controls
0.05 NO2/NOx ratio C0004
50 m FL
Max DV: 930 µg/m3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

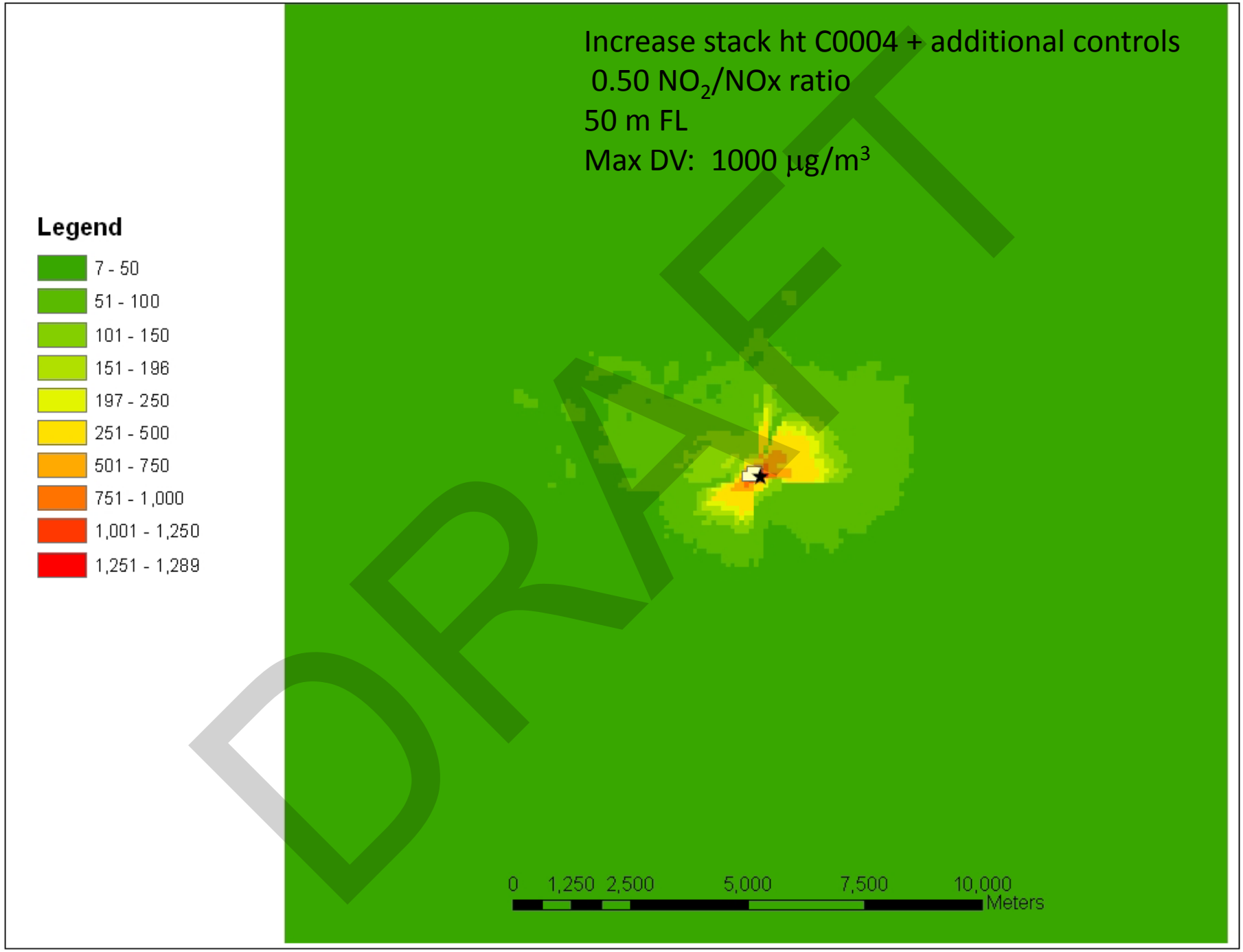

Increase stack ht C0004 + additional controls
0.1 NO_2/NOx ratio
300 m FL
Max DV: 543 µg/m³
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

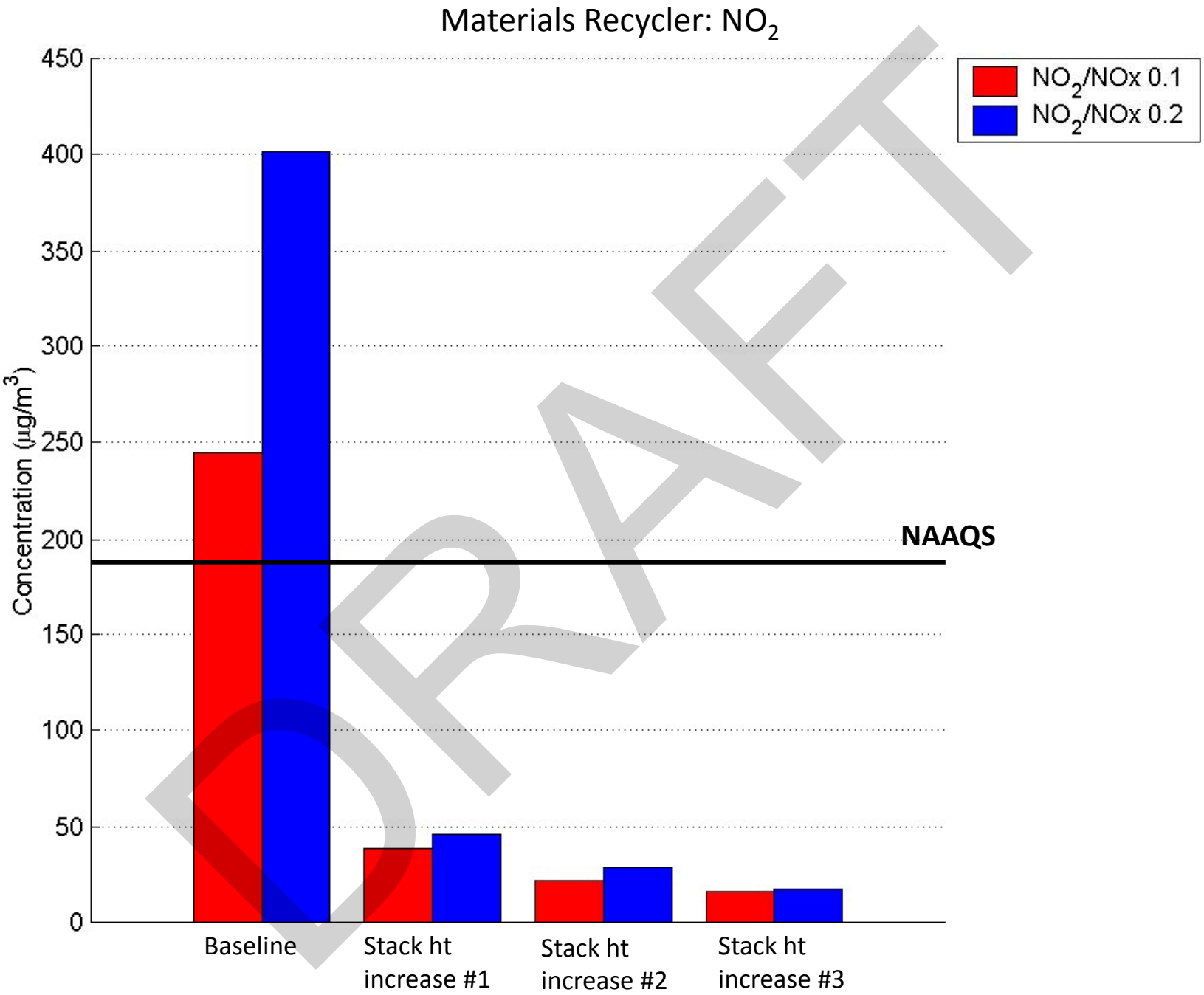

Increase stack ht C0004 + additional controls
0.05 NO_2/NOx ratio C0004
300 m FL
Max DV: 543 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Increase stack ht C0004 + additional controls
0.1 NO_2/NOx ratio
50 m FL
Max DV: 810 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Increase stack ht C0004 + additional controls
0.05 NO_2/NOx ratio C0004
50 m FL
Max DV: 930 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

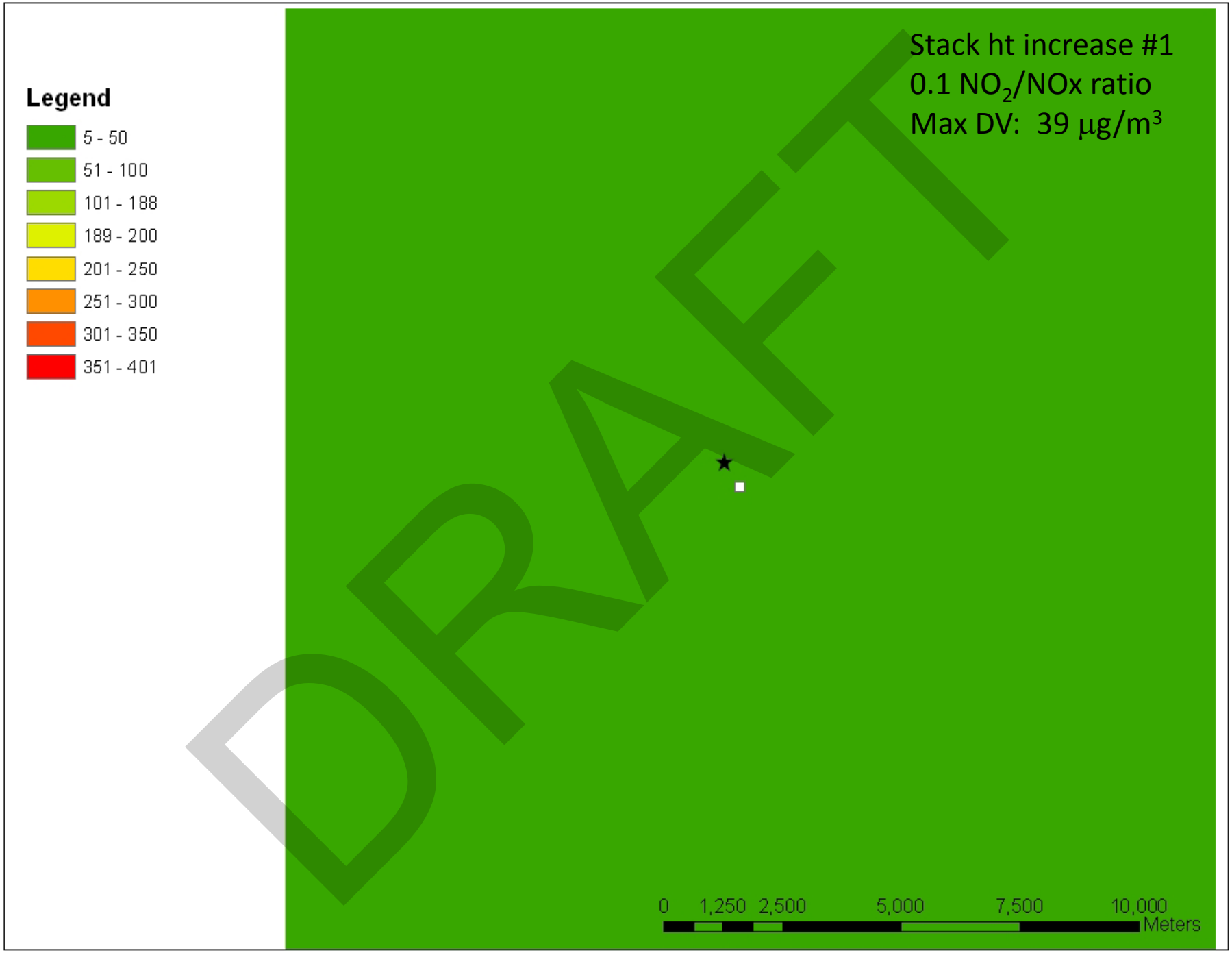

Increase stack ht C0004 + additional controls
0.25 NO_2/NOx ratio
50 m FL
Max DV: 1000 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

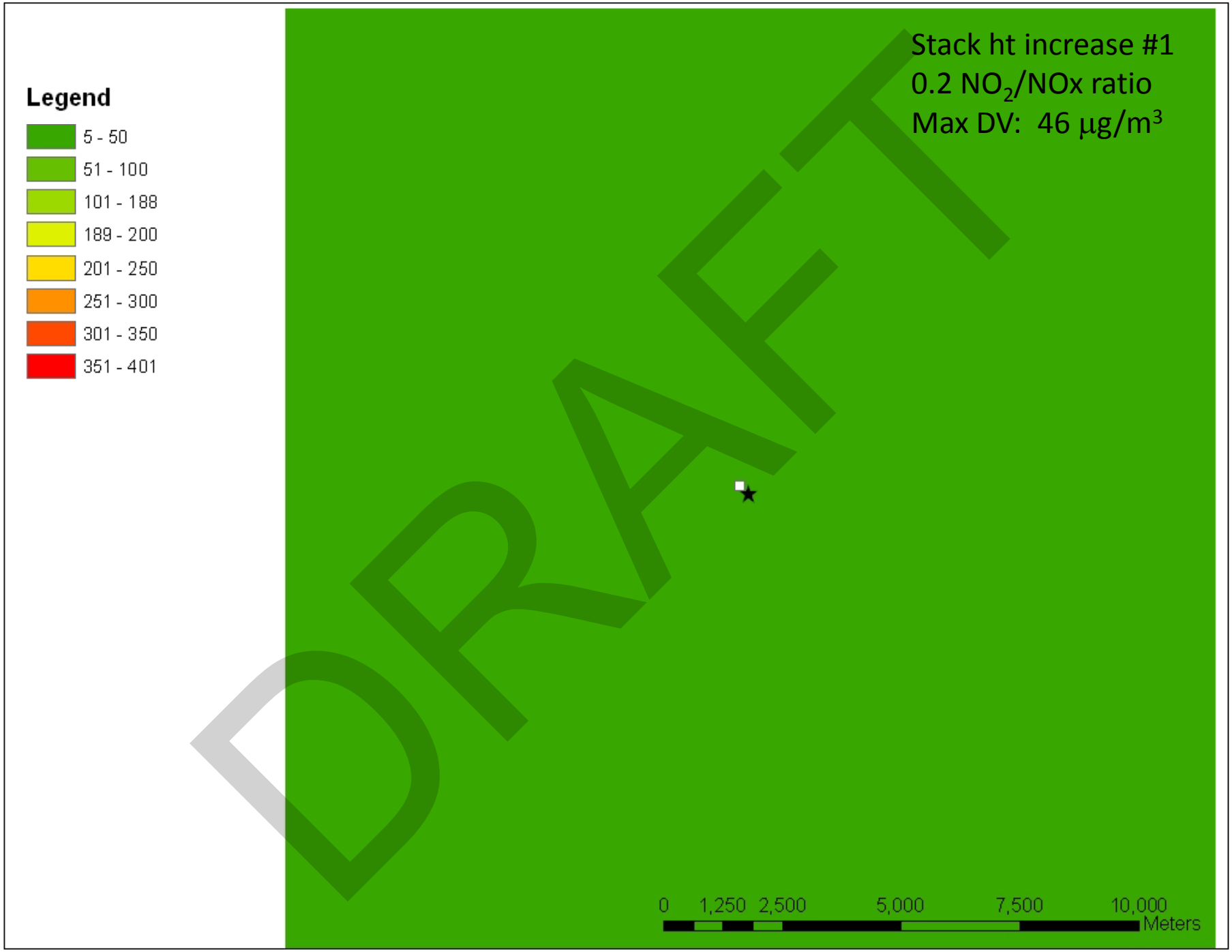

Increase stack ht C0004 + additional controls
0.50 NO_2/NOx ratio
50 m FL
Max DV: 1000 µg/m^3
Legend
7 - 50
51 - 100
101 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,289
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

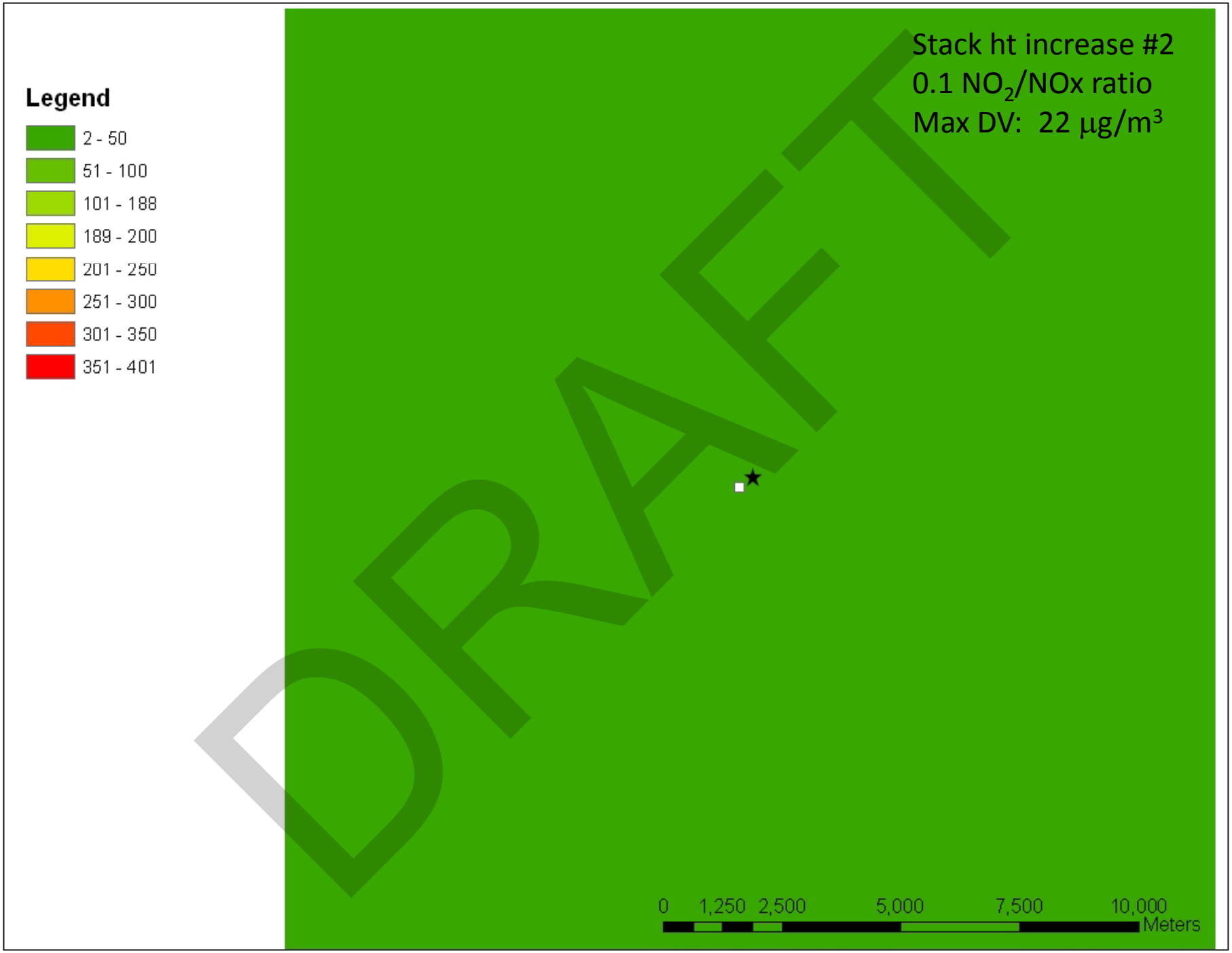

Materials Recycler: NO2
NO2/NOx 0.1
NO2/NOx 0.2
Concentration (µg/m3)
450
400
350
300
250
200
150
100
50
0
NAAQS
Baseline
Stack ht increase #1
Stack ht increase #2
Stack ht increase #3

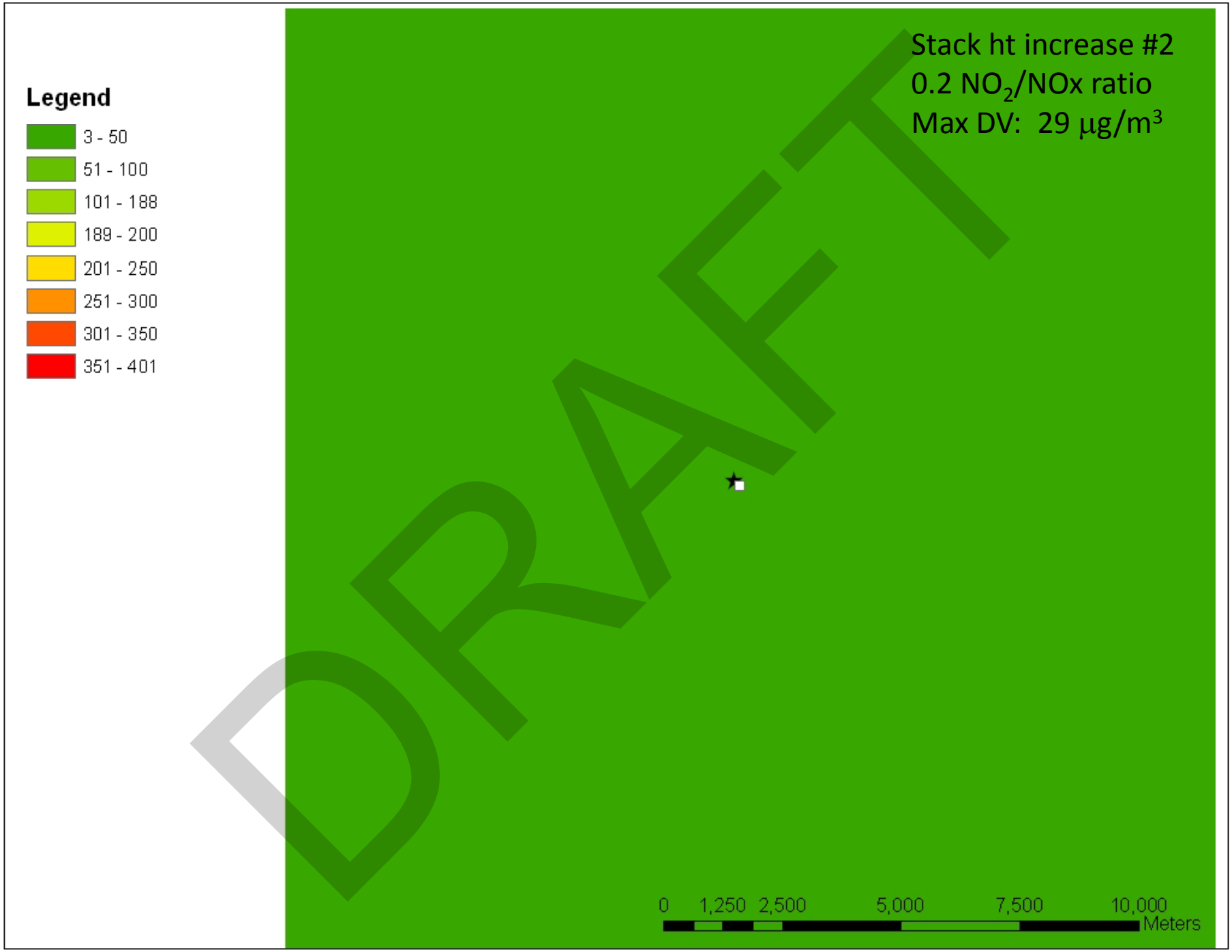

Legend
8 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Base
0.1 NO2/NOx ratio
Max DV: 244 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

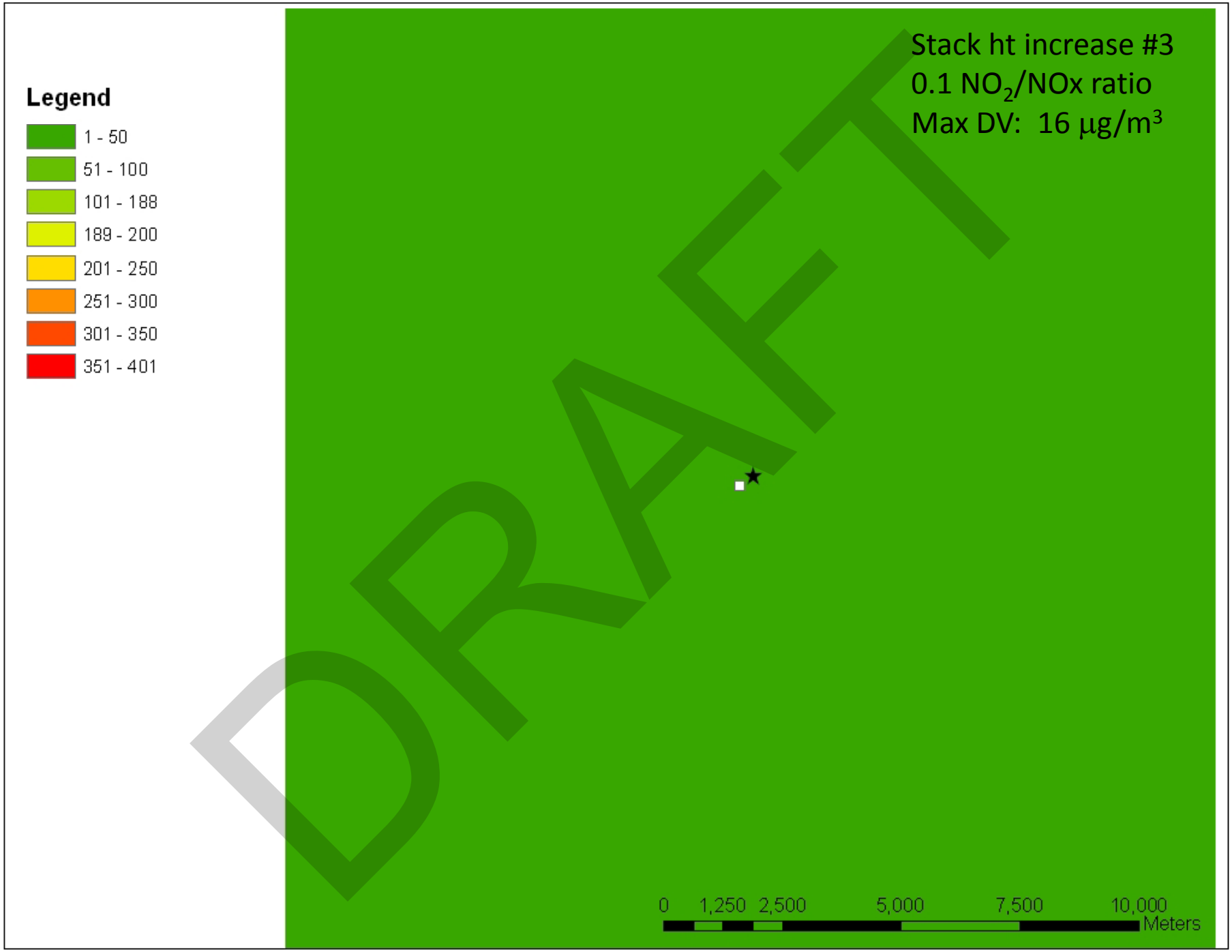

Legend
8 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Base
0.2 NO2/NOx ratio
Max DV: 401 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

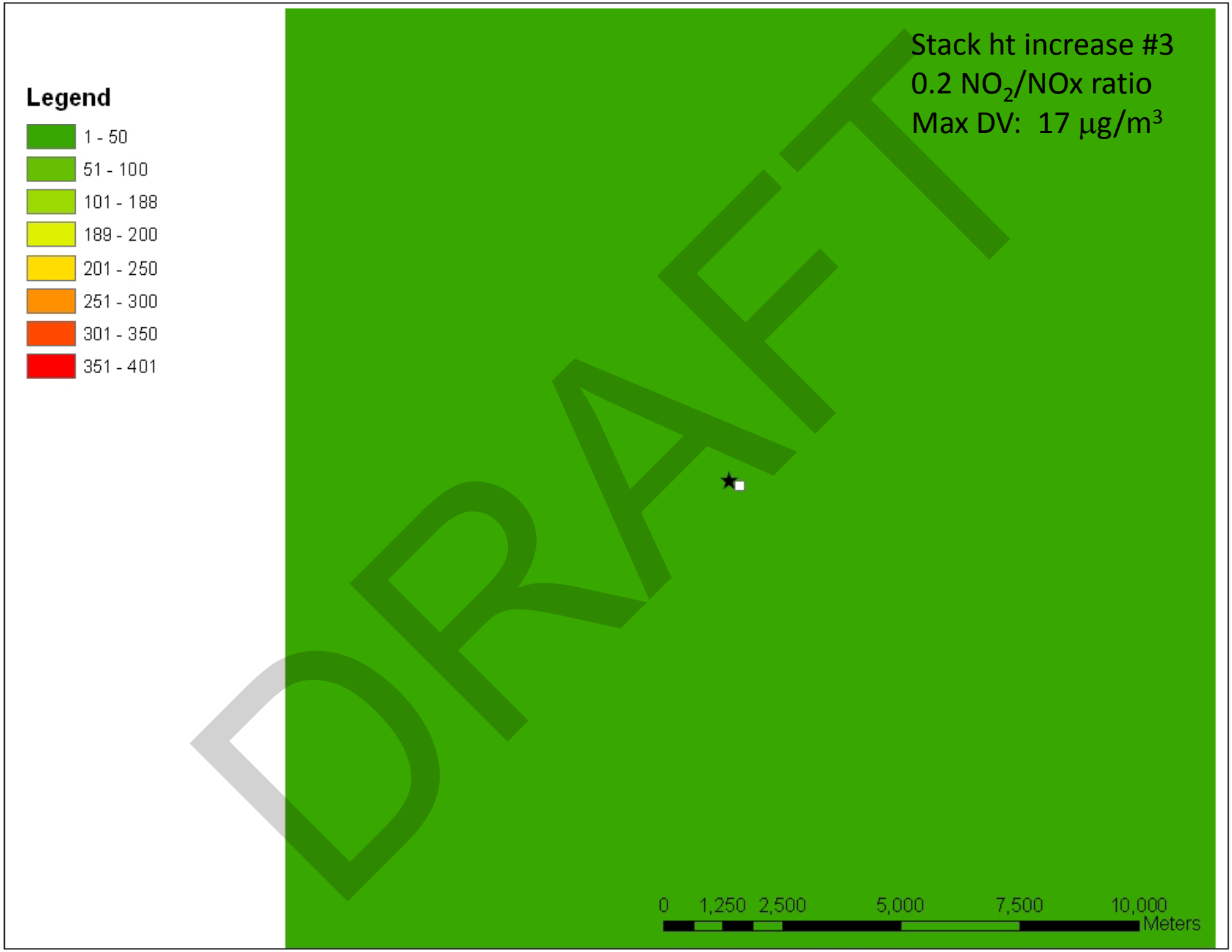

Legend
5 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #1
0.1 NO2/NOx ratio
Max DV: 39 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
5 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #1
0.2 NO2/NOx ratio
Max DV: 46 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

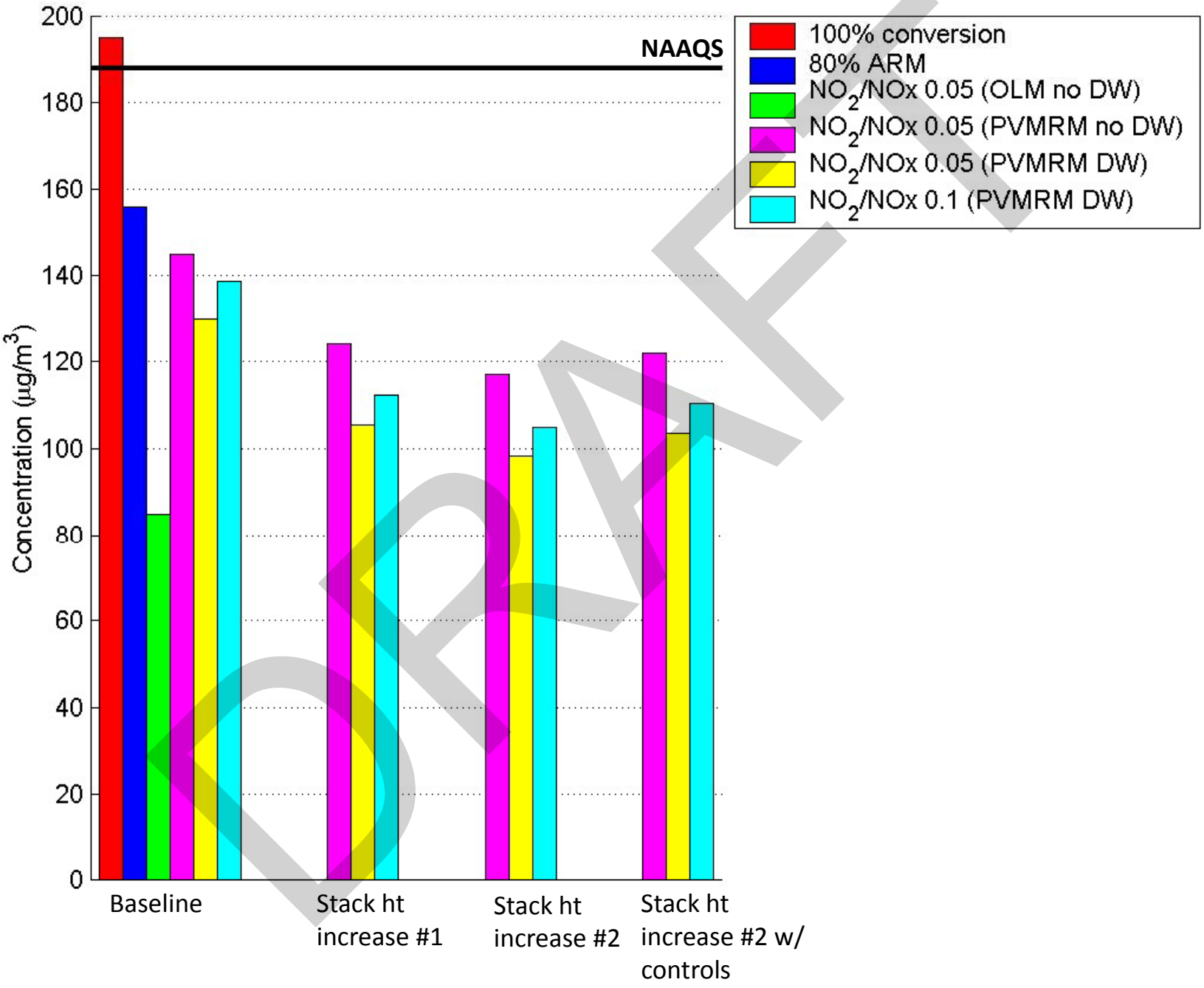

Legend
2 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #2
0.1 NO2/NOx ratio
Max DV: 22 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
3 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #2
0.2 NO2/NOx ratio
Max DV: 29 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

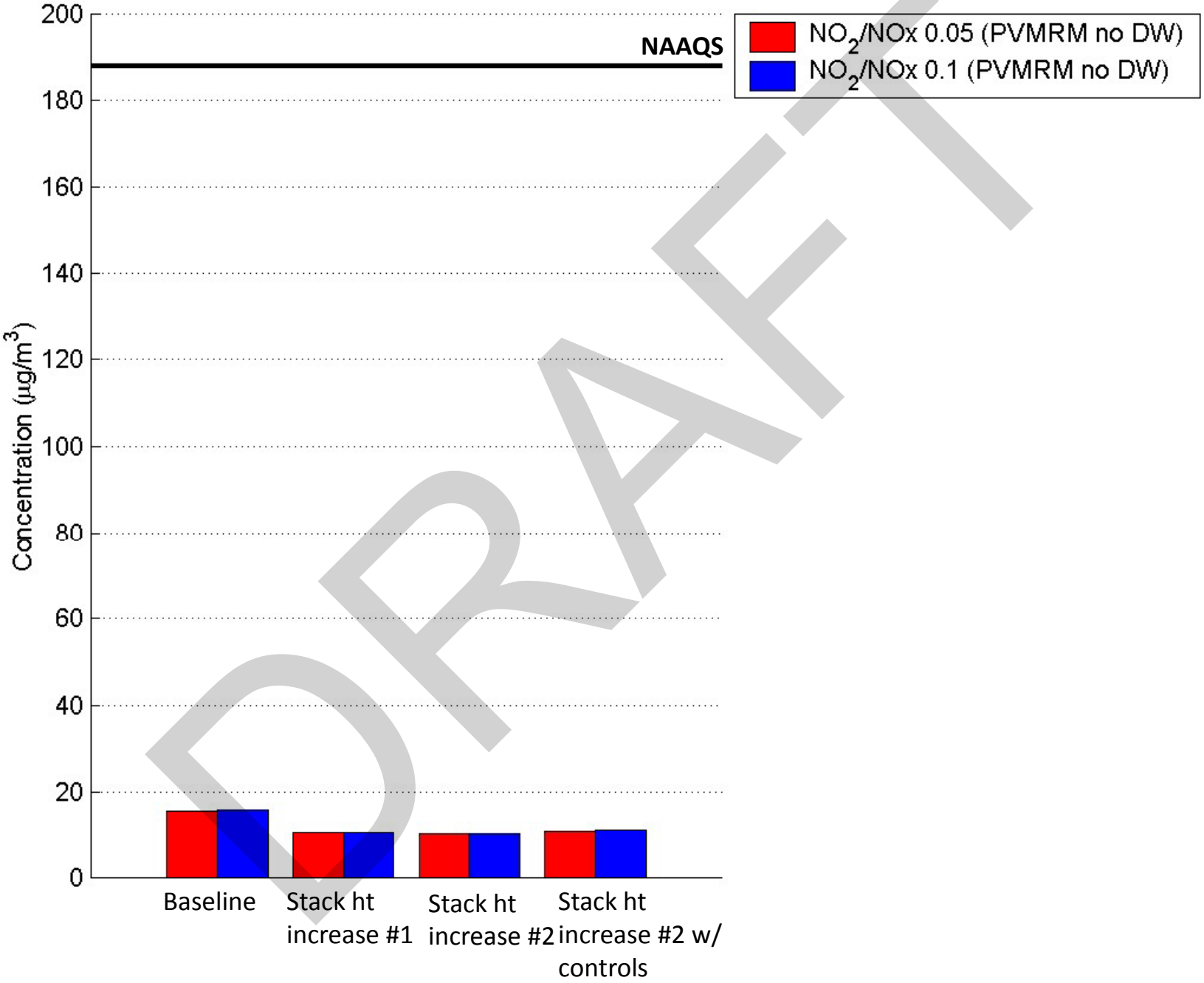

Legend
1 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #3
0.1 NO2/NOx ratio
Max DV: 16 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

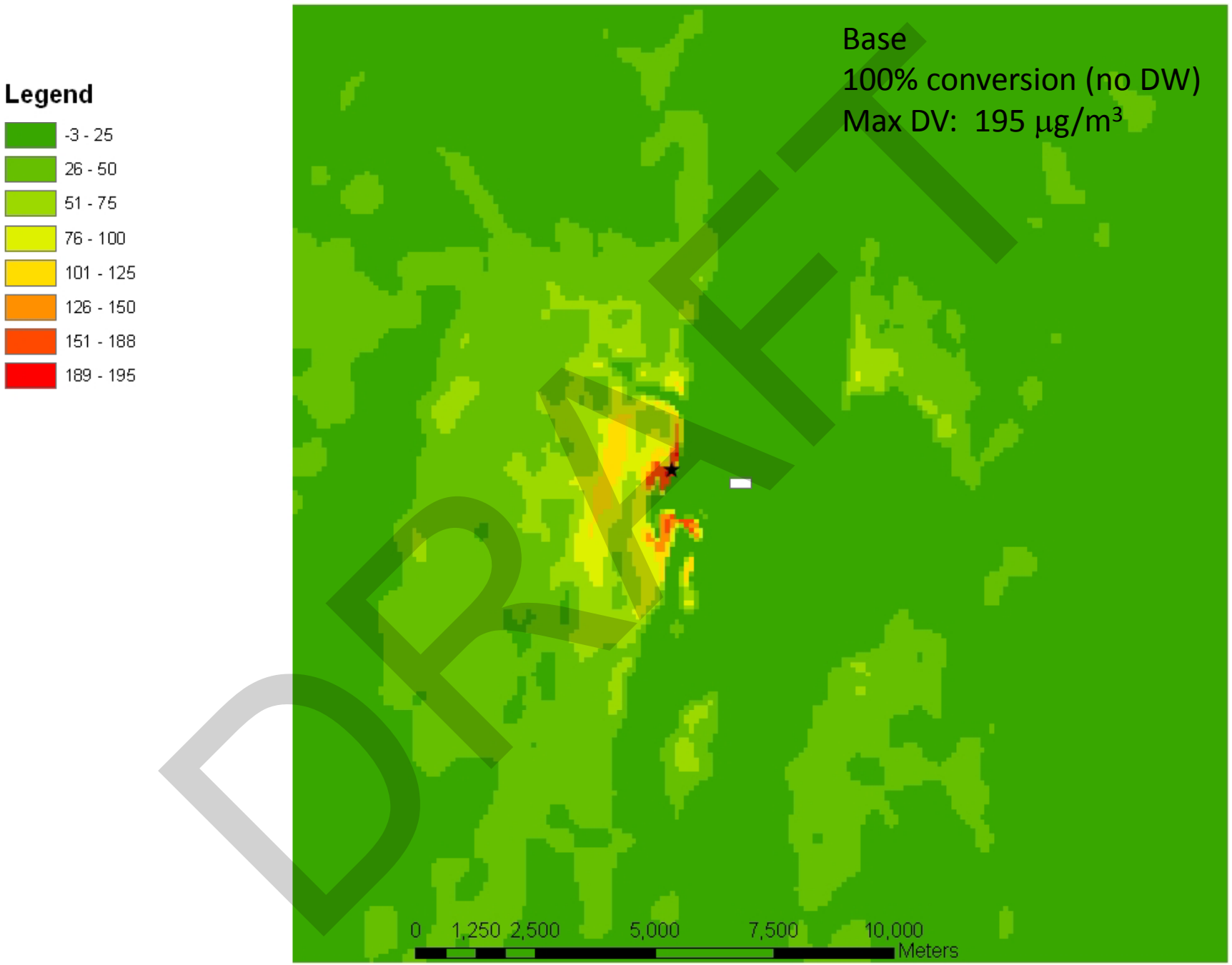

Legend
1 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 350
351 - 401
Stack ht increase #3
0.2 NO2/NOx ratio
Max DV: 17 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

Natural Gas Turbine (NY): NO_2

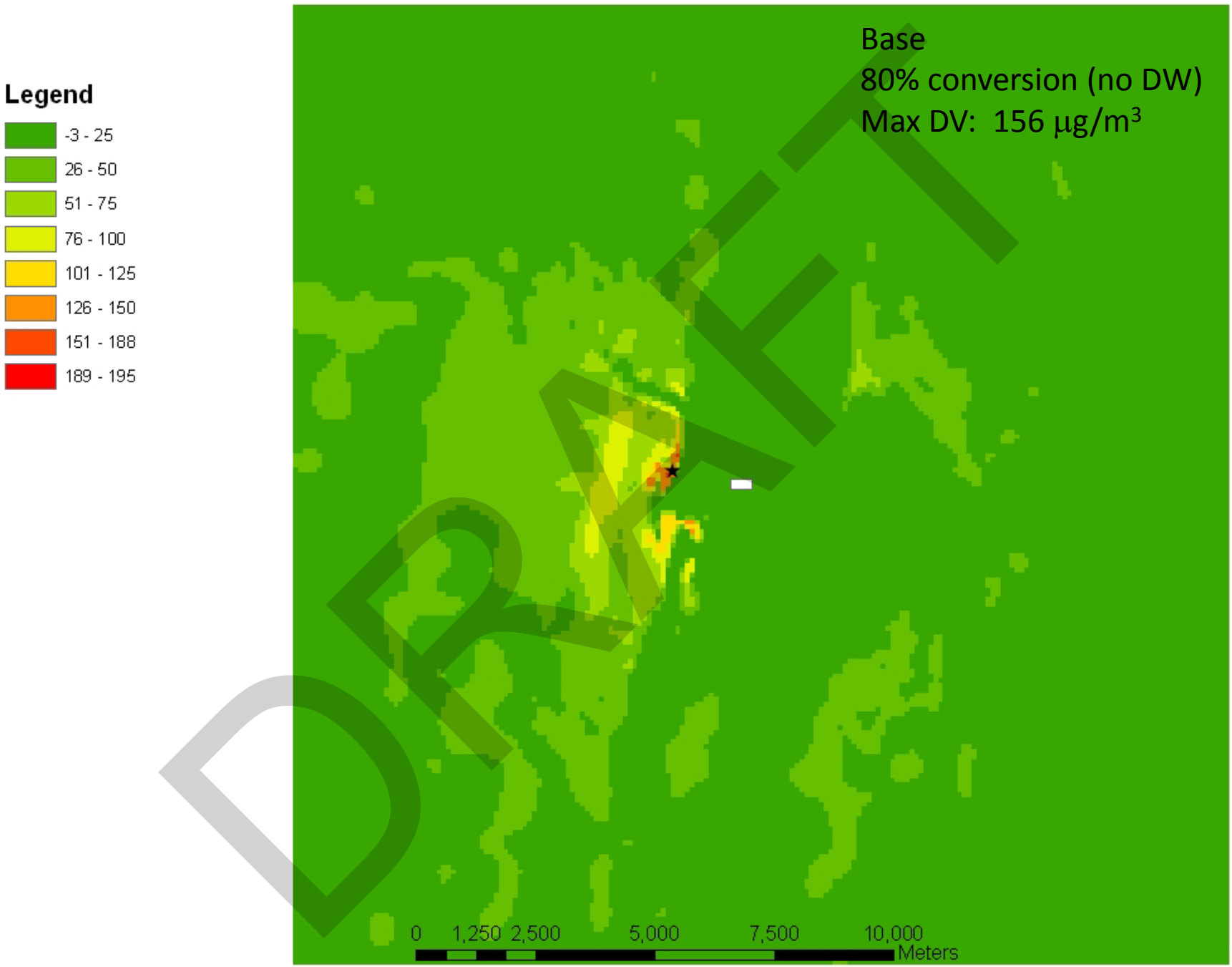


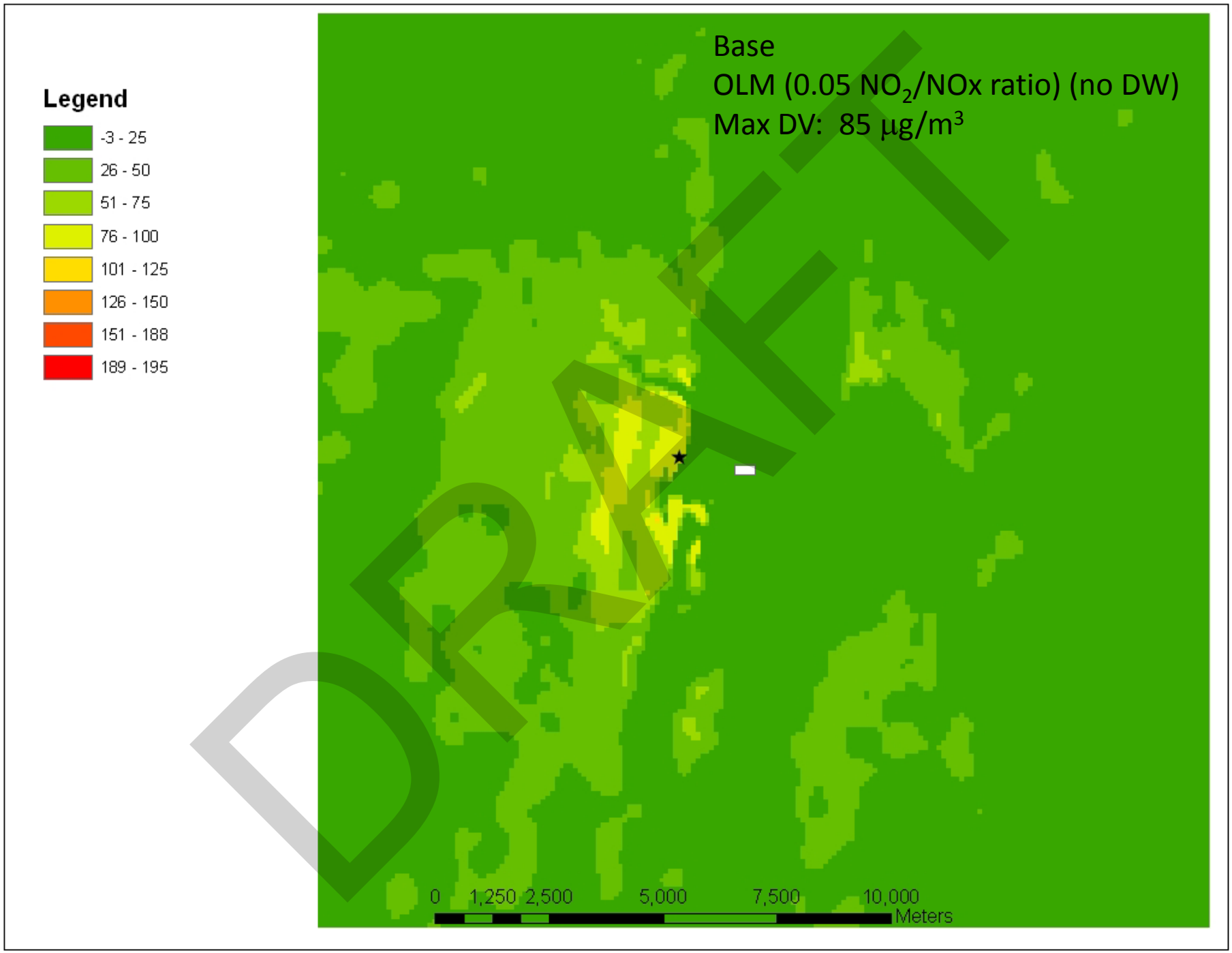
Natural Gas Turbine (MS): NO_2

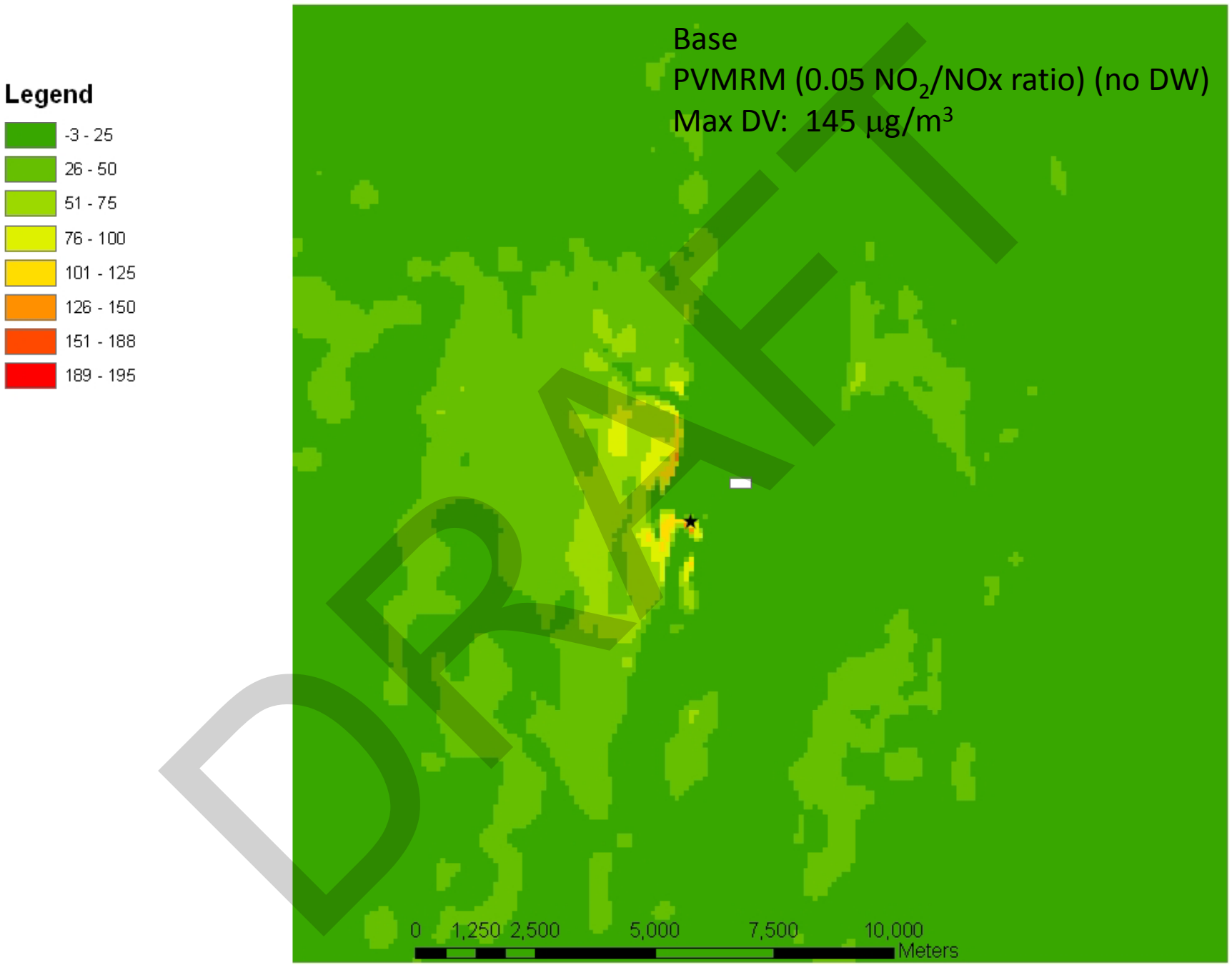


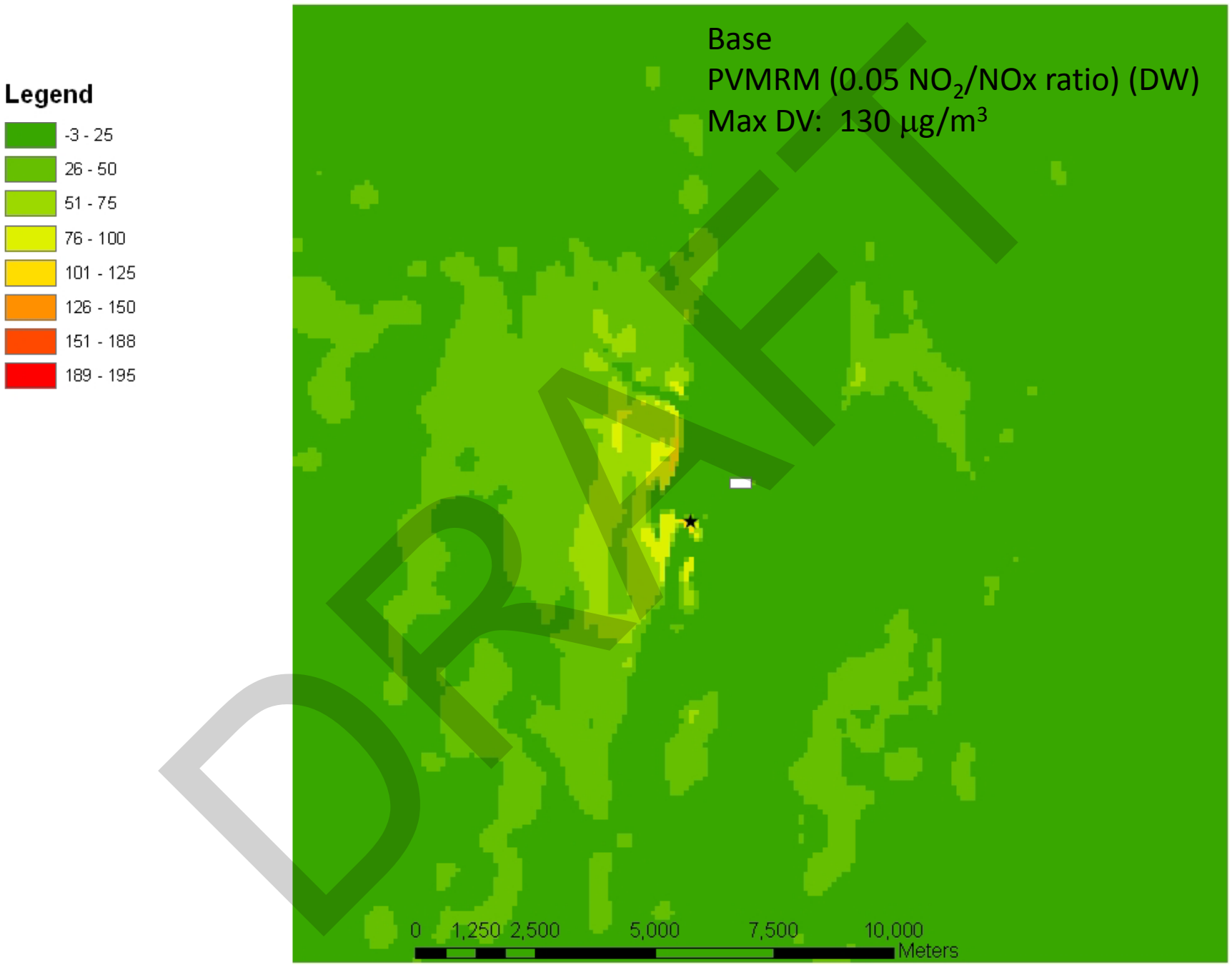

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Base
100% conversion (no DW)
Max DV: 195 µg/m³
0
1,250
2,500
5,000
7,500
10,000
Meters

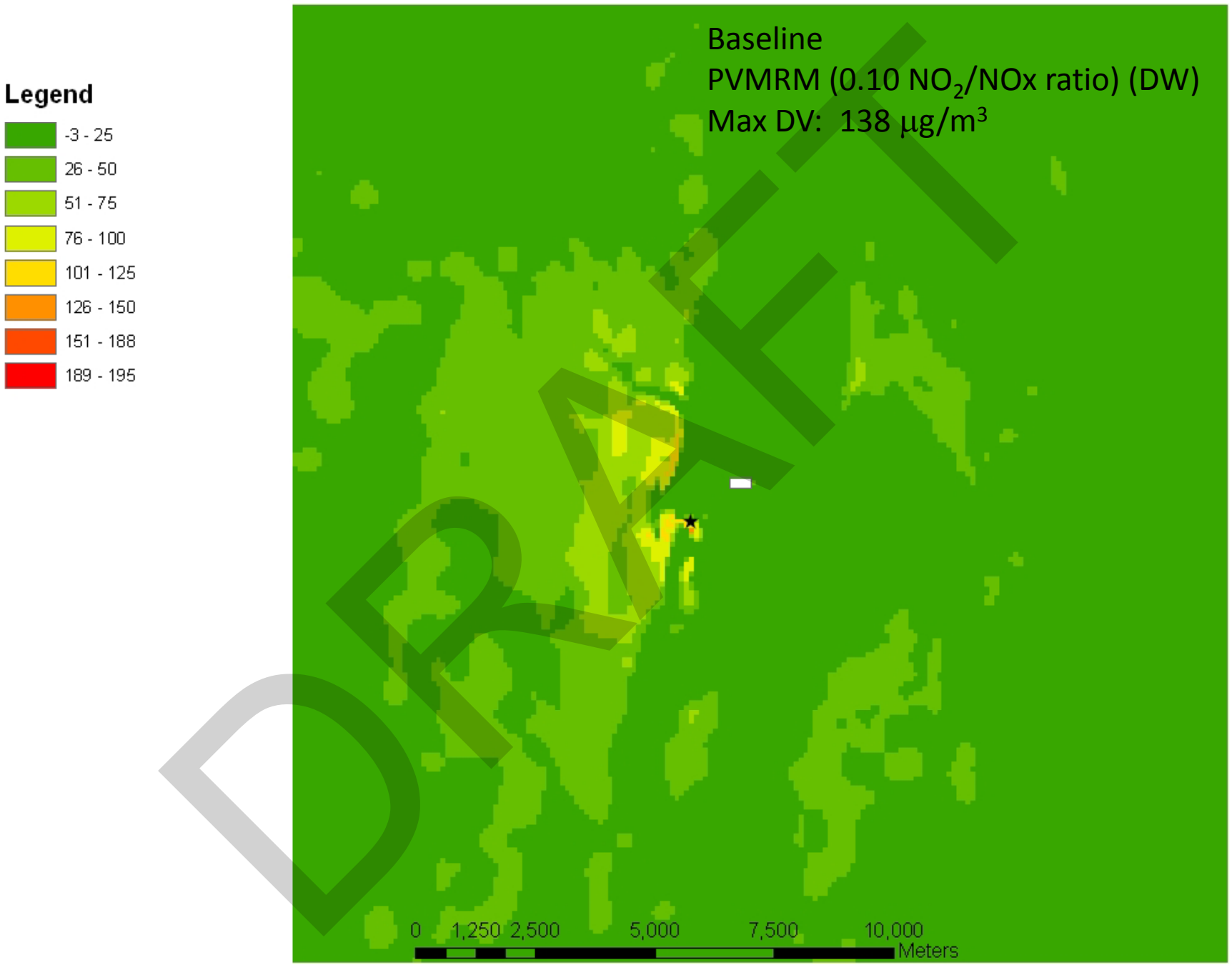
Contour Plots – NY case

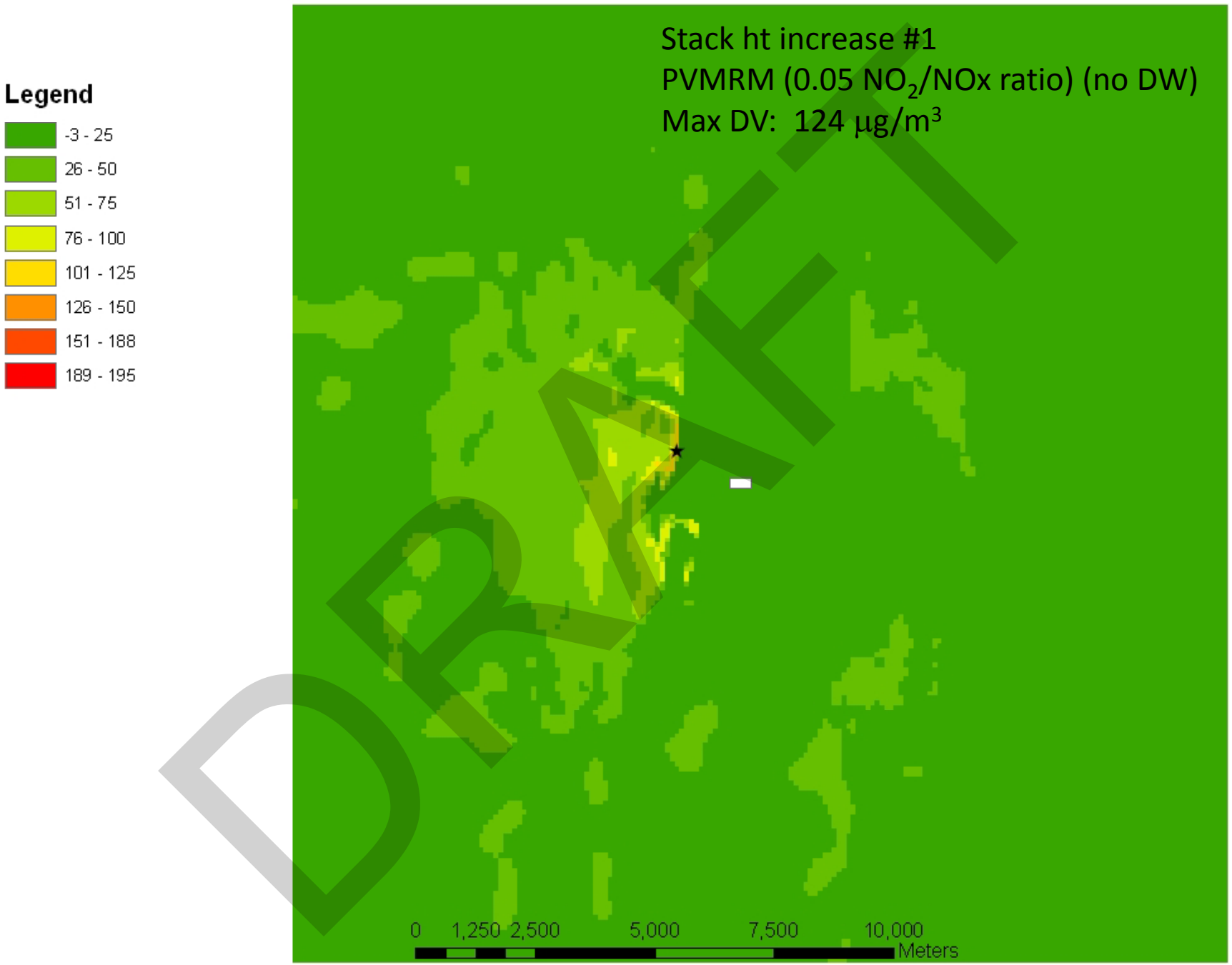

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Base
80% conversion (no DW)
Max DV: 156 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters

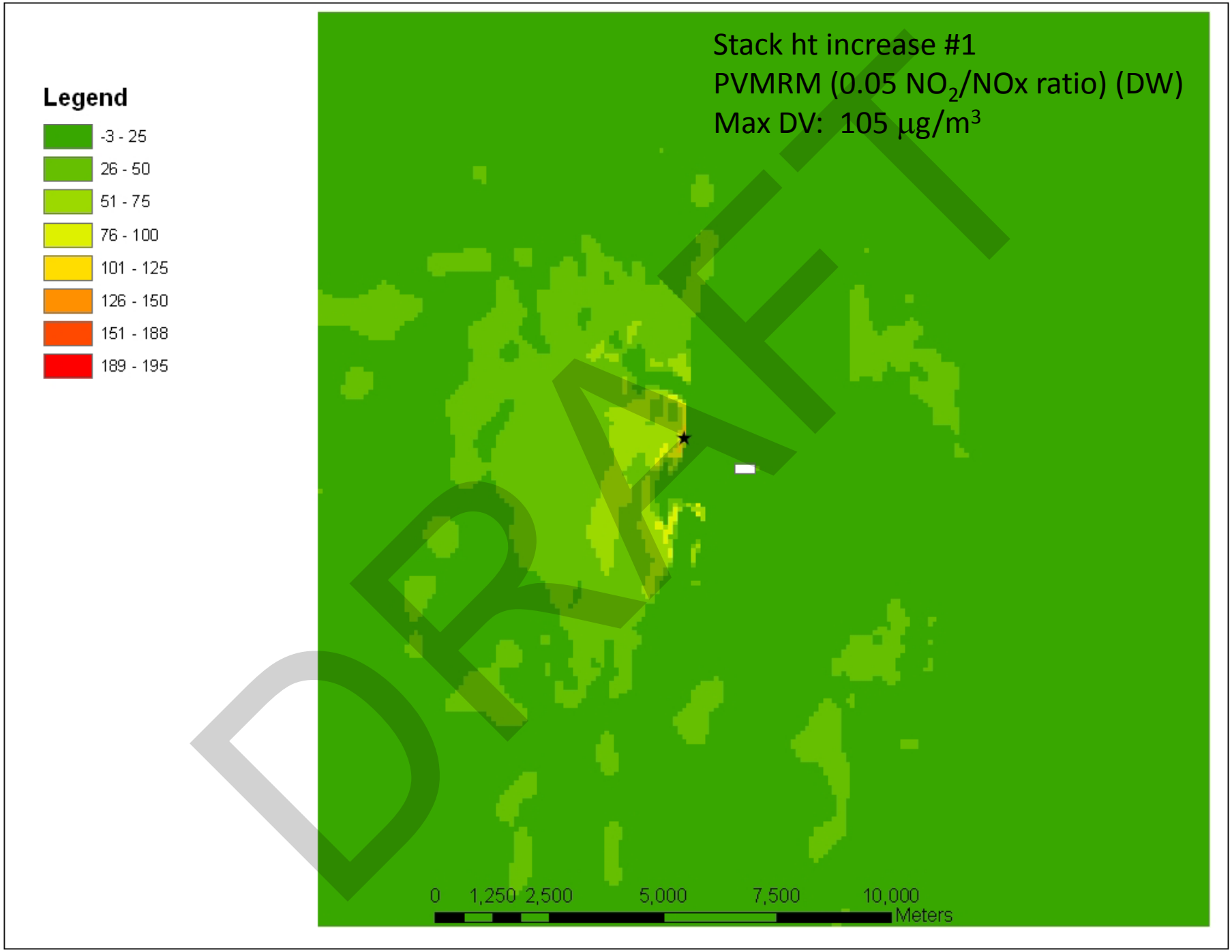

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Base
OLM (0.05 NO2/NOx ratio) (no DW)
Max DV: 85 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters

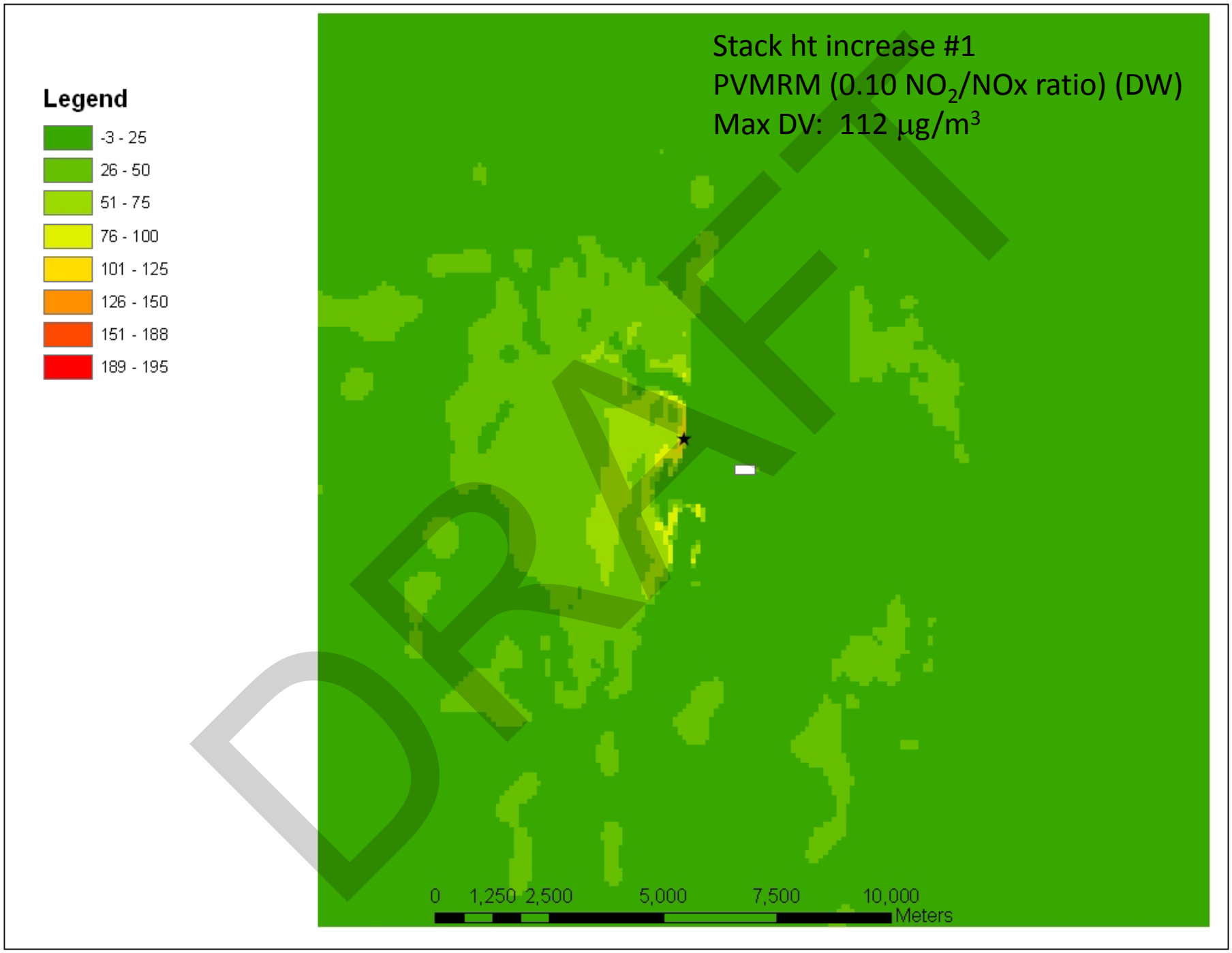

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Base
PVMRM (0.05 NO2/NOx ratio) (no DW)
Max DV: 145 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters

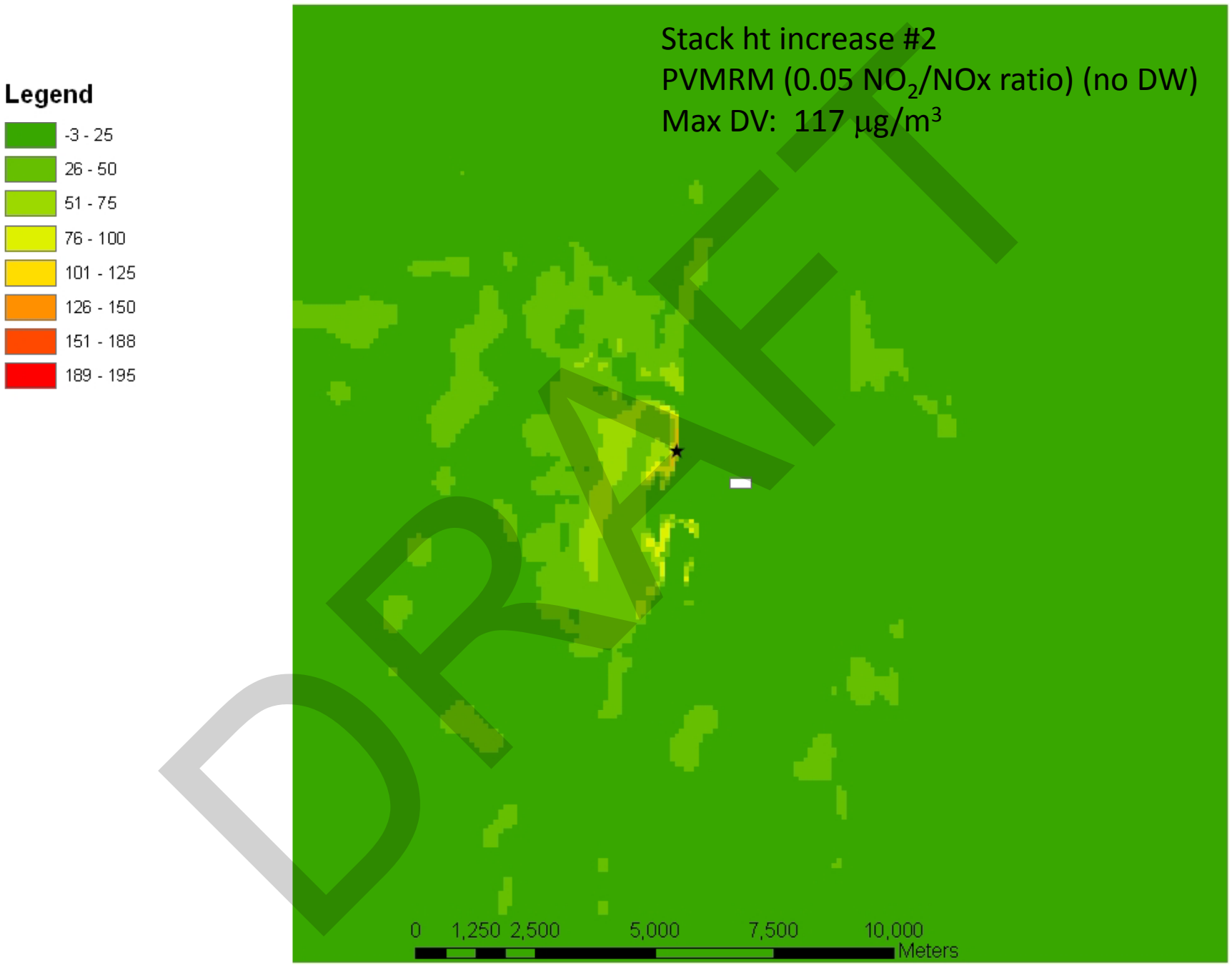

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Base
PVMRM (0.05 NO2/NOx ratio) (DW)
Max DV: 130 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters

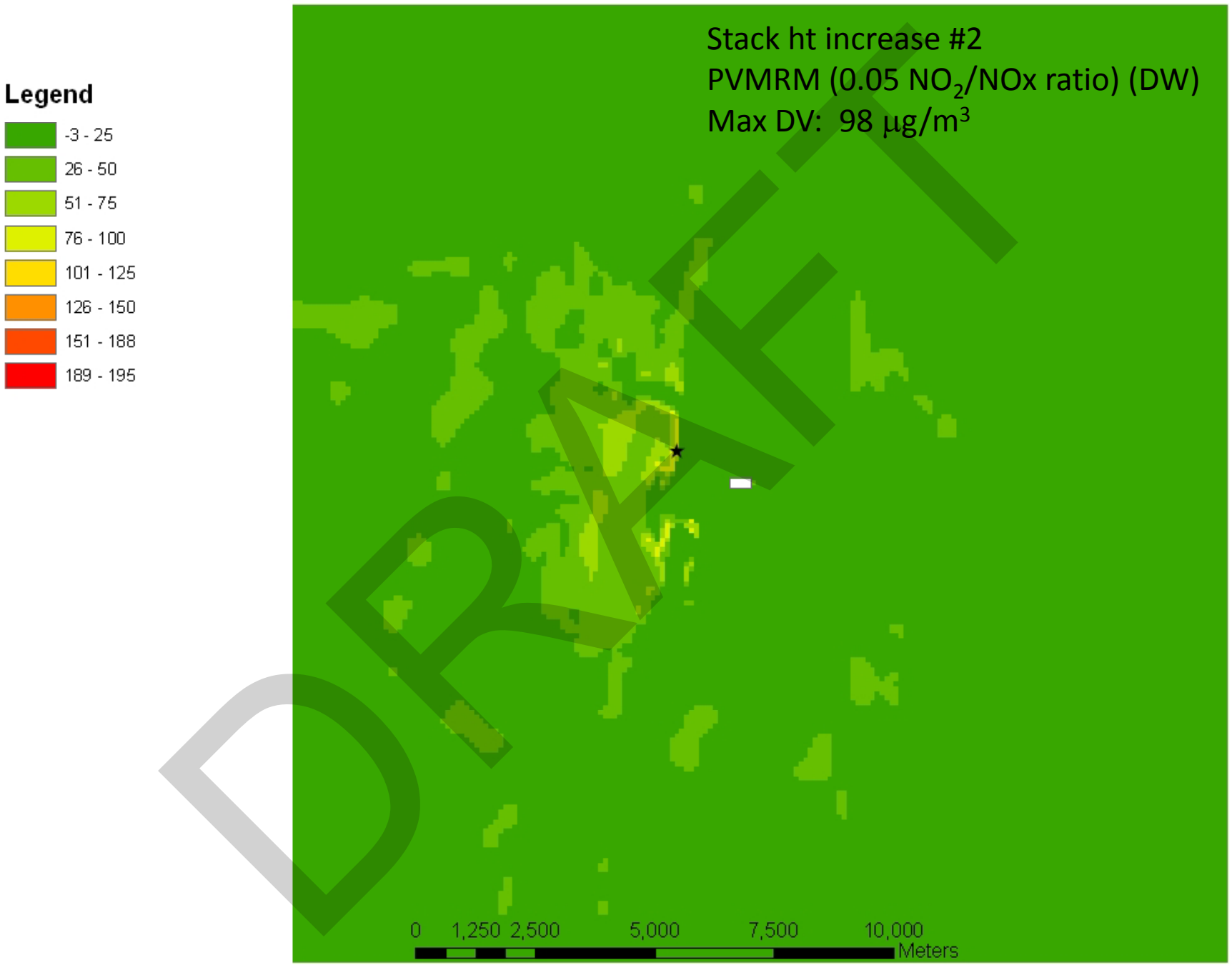

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Baseline
PVMRM (0.10 NO2/NOx ratio) (DW)
Max DV: 138 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters

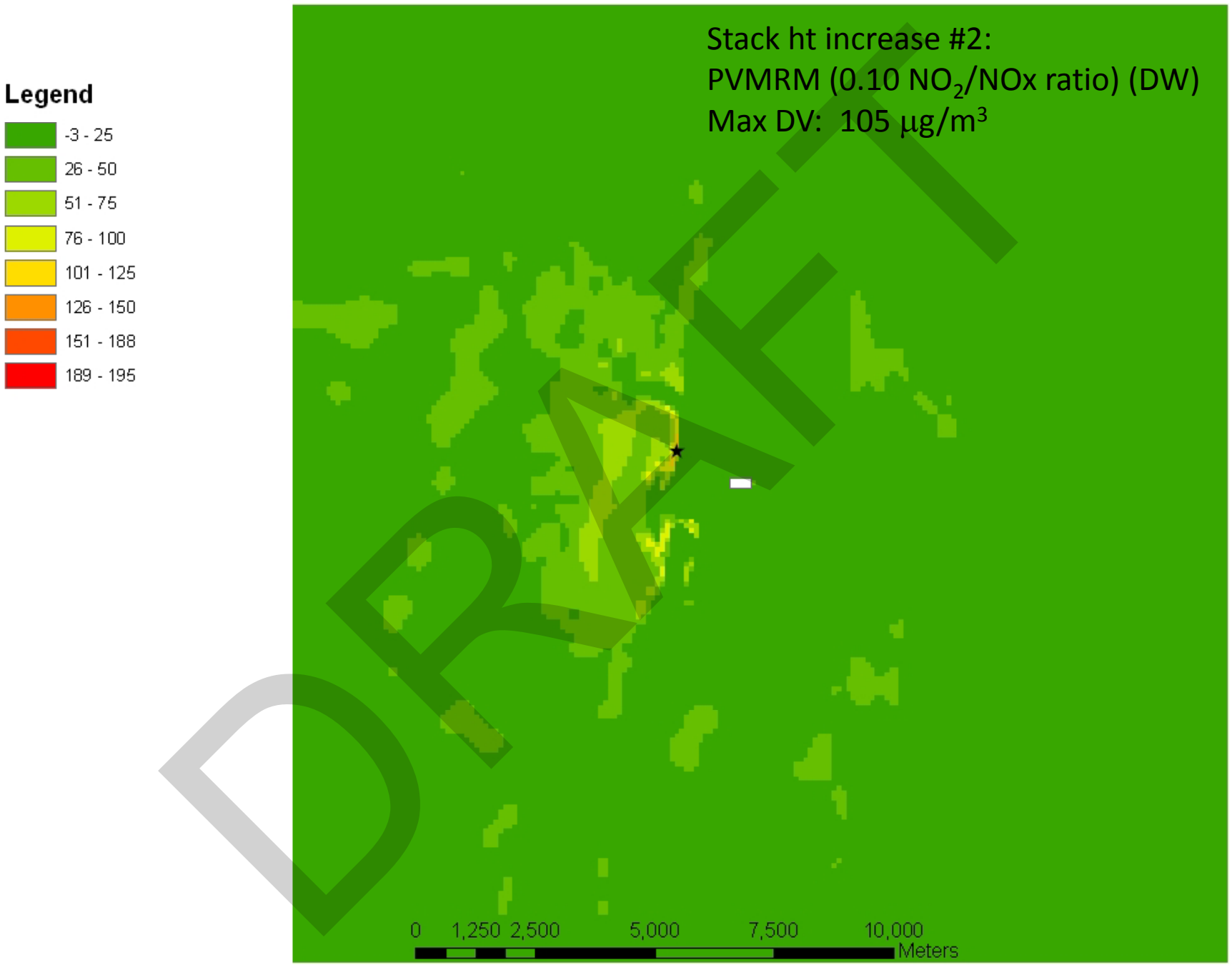

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #1
PVMRM (0.05 NO2/NOx ratio) (no DW)
Max DV: 124 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

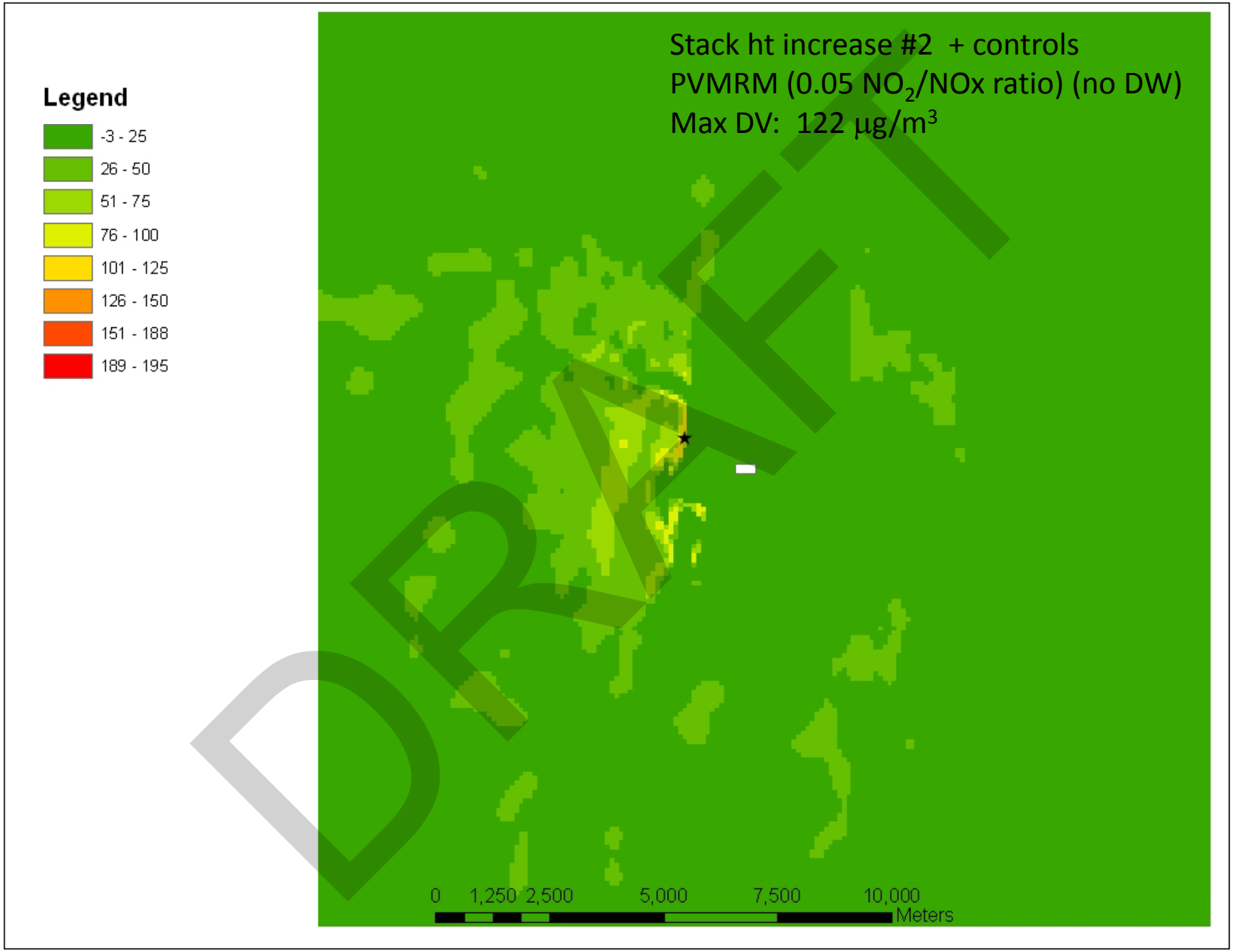

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #1
PVMRM (0.05 NO2/NOx ratio) (DW)
Max DV: 105 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

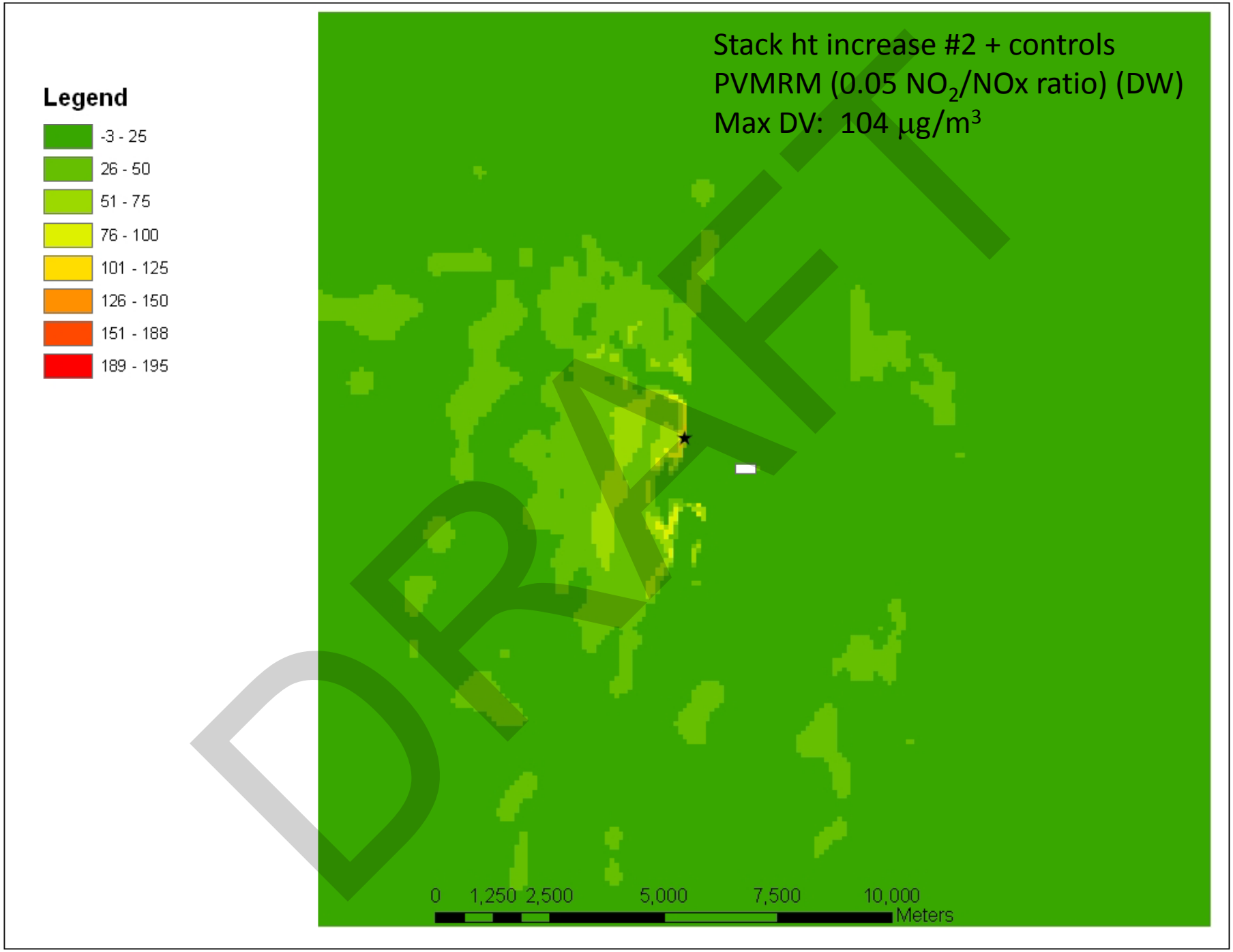

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #1
PVMRM (0.10 NO2/NOx ratio) (DW)
Max DV: 112 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

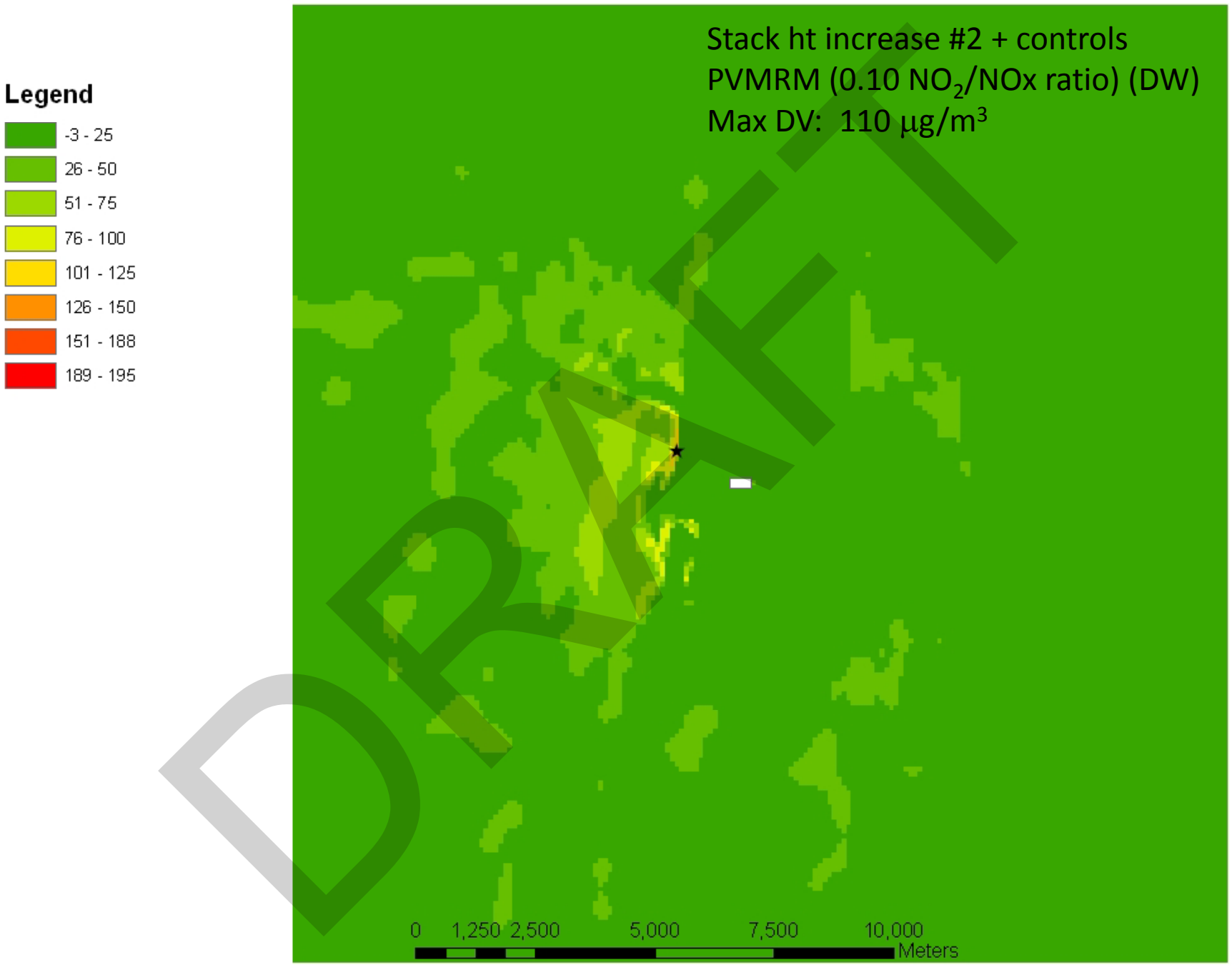

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2
PVMRM (0.05 NO2/NOx ratio) (no DW)
Max DV: 117 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters

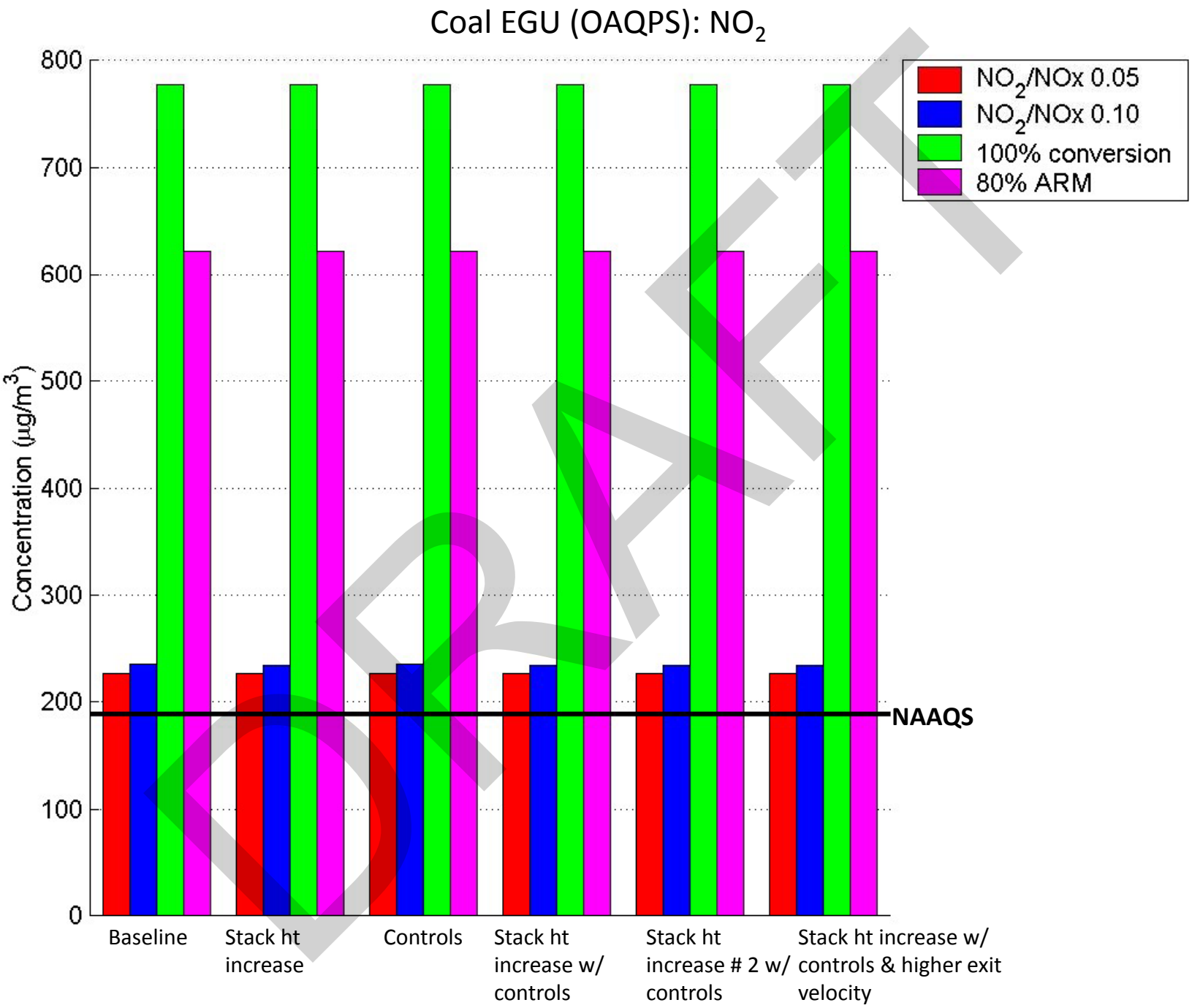

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2
PVMRM (0.05 NO2/NOx ratio) (DW)
Max DV: 98 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

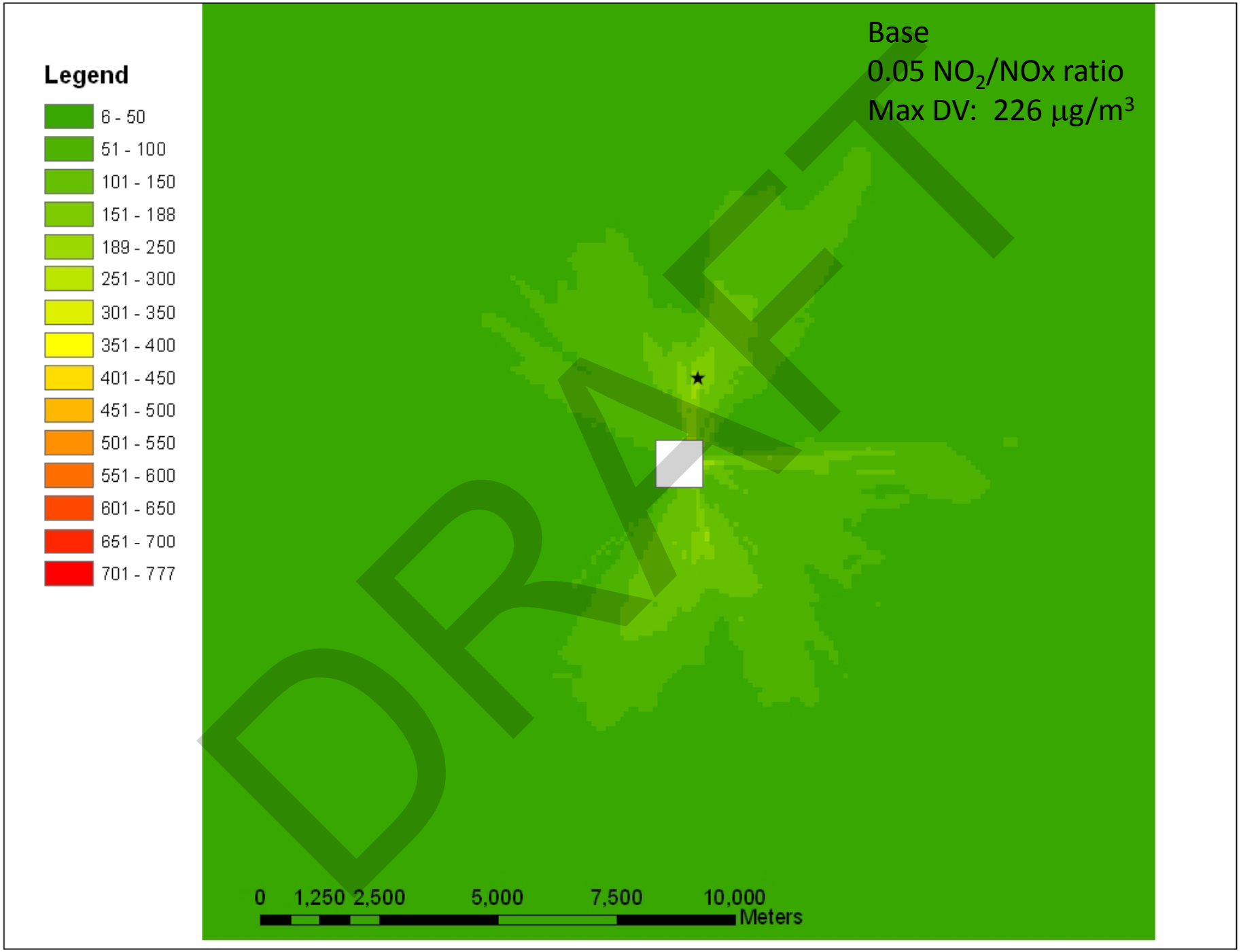

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2:
PVMRM (0.10 NO2/NOx ratio) (DW)
Max DV: 105 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

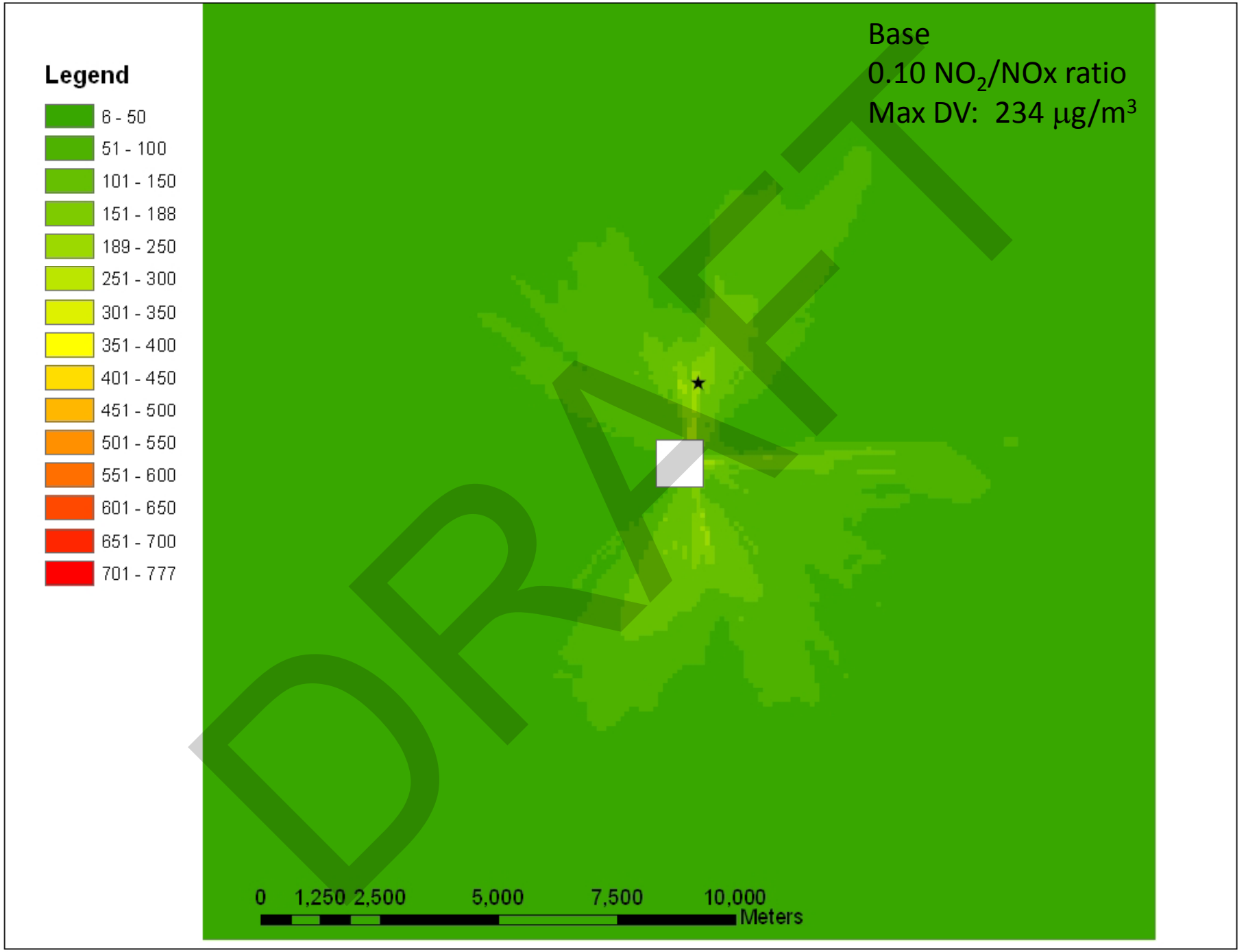

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2 + controls
PVMRM (0.05 NO2/NOx ratio) (no DW)
Max DV: 122 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

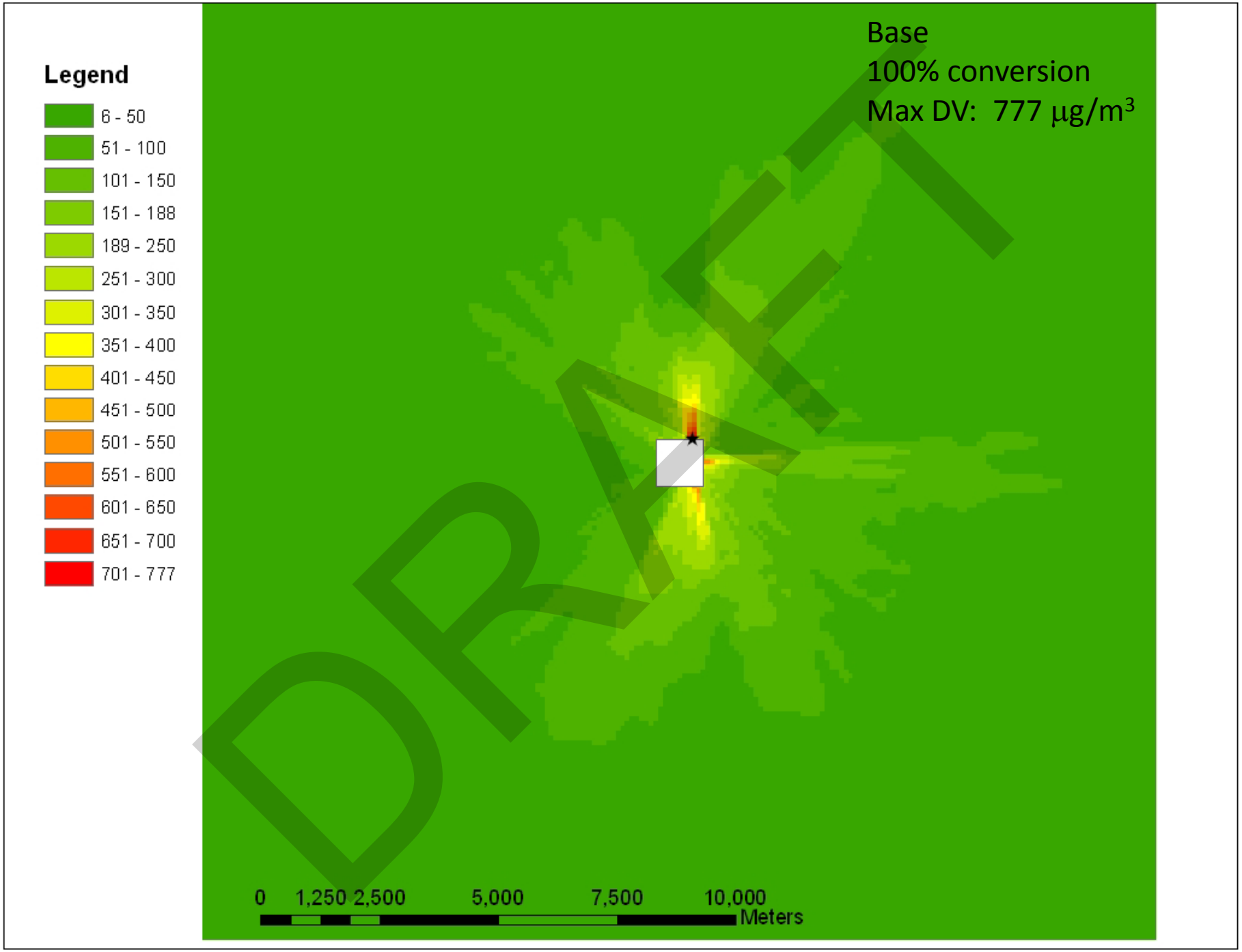

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2 + controls
PVMRM (0.05 NO2/NOx ratio) (DW)
Max DV: 104 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

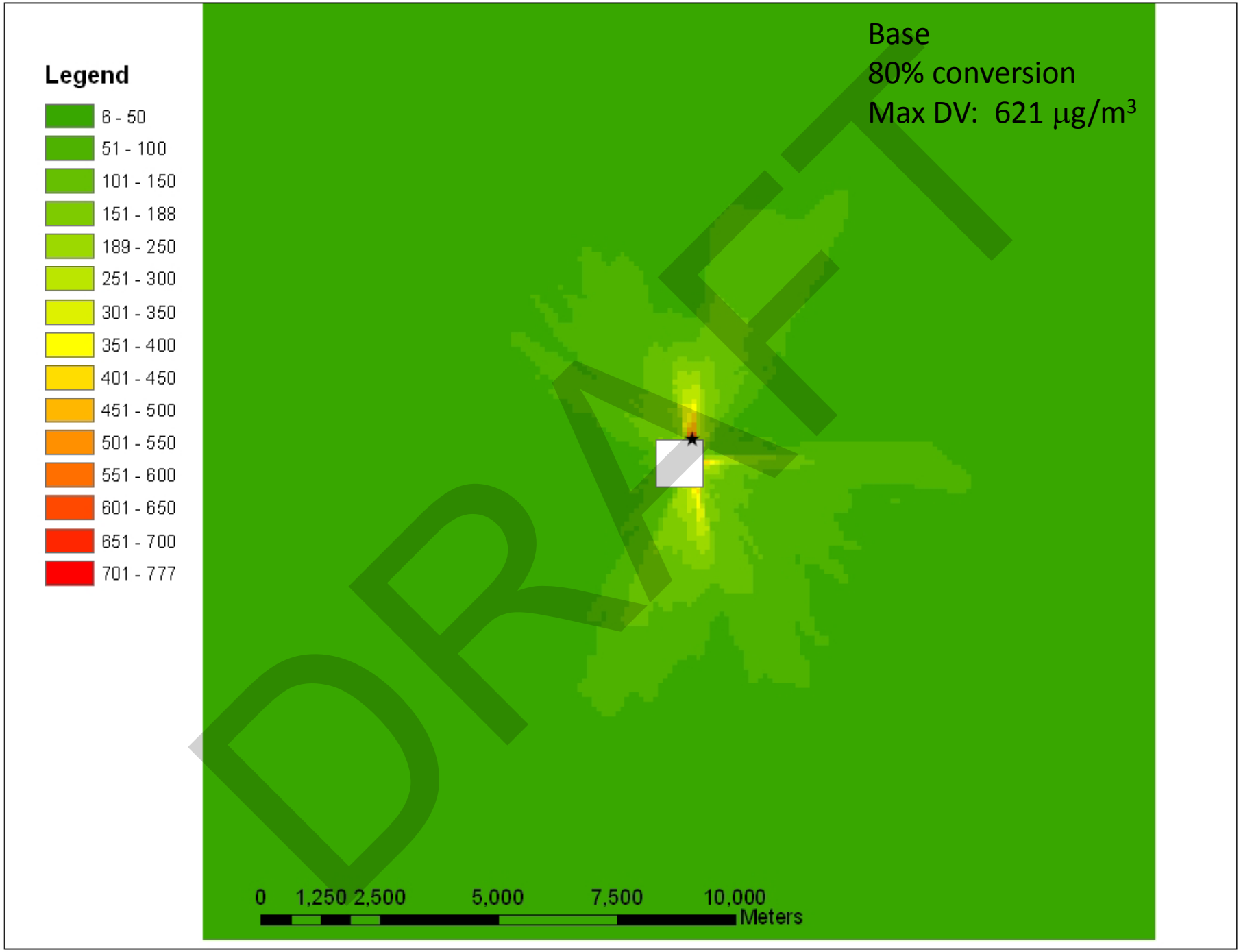

Legend
-3 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 195
Stack ht increase #2 + controls
PVMRM (0.10 NO2/NOx ratio) (DW)
Max DV: 110 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

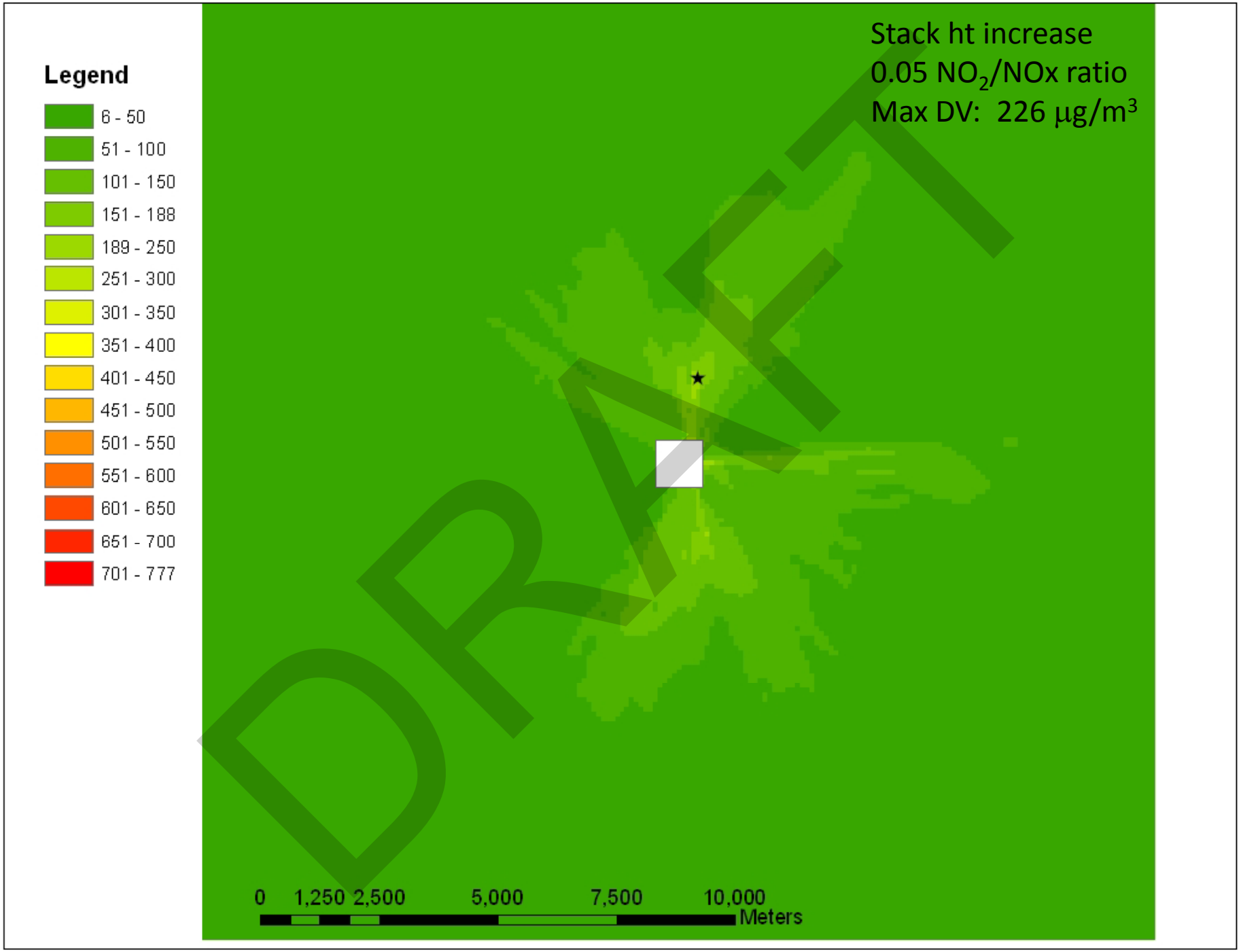

Coal EGU (OAQPS): NO2
NO2/NOx 0.05
NO2/NOx 0.10
100% conversion
80% ARM
Concentration (µg/m3)
800
700
600
500
400
300
200
100
0
NAAQS
Baseline
Stack ht increase
Controls
Stack ht increase w/ controls
Stack ht increase # 2 w/ controls
Stack ht increase w/ controls & higher exit velocity

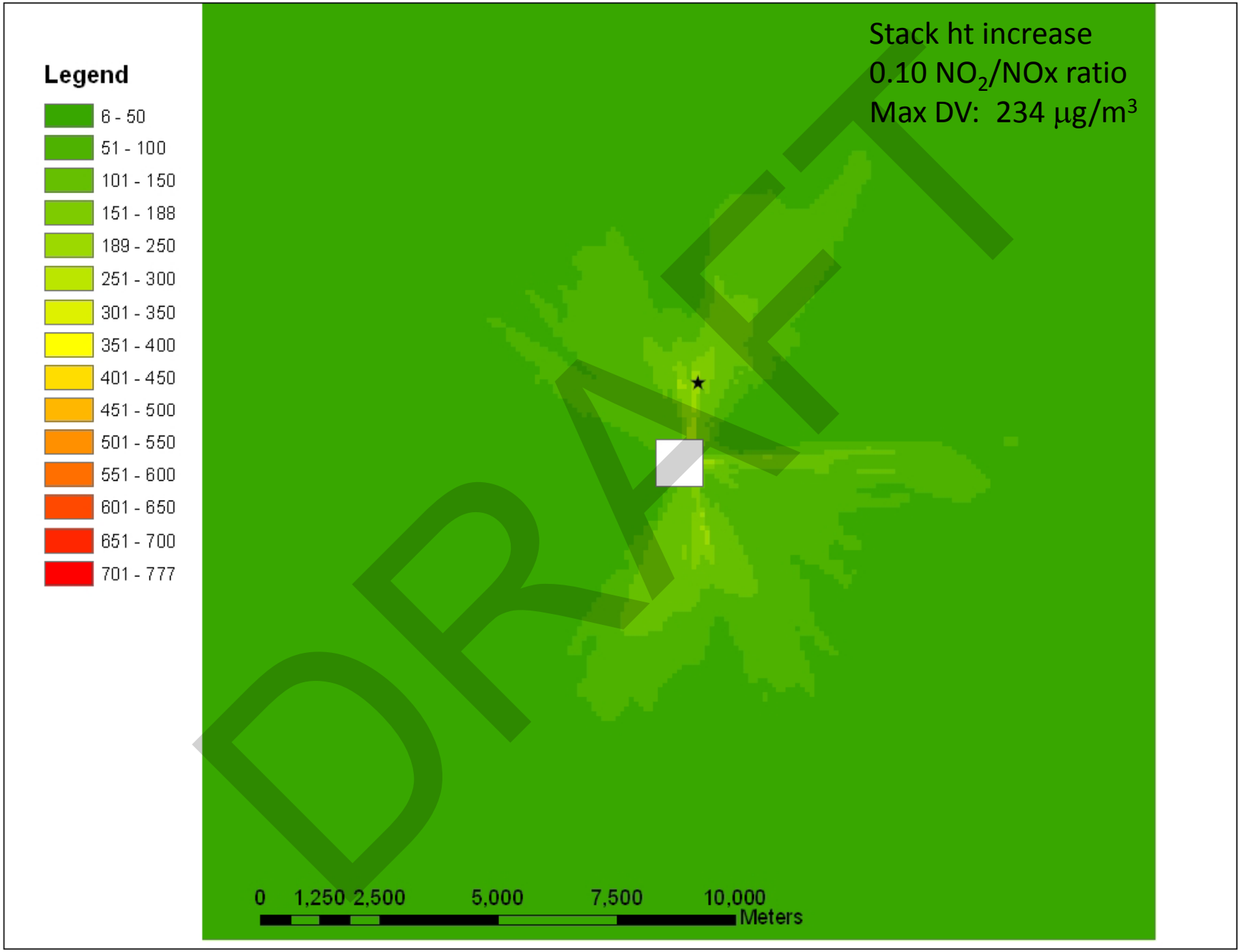

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Base
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

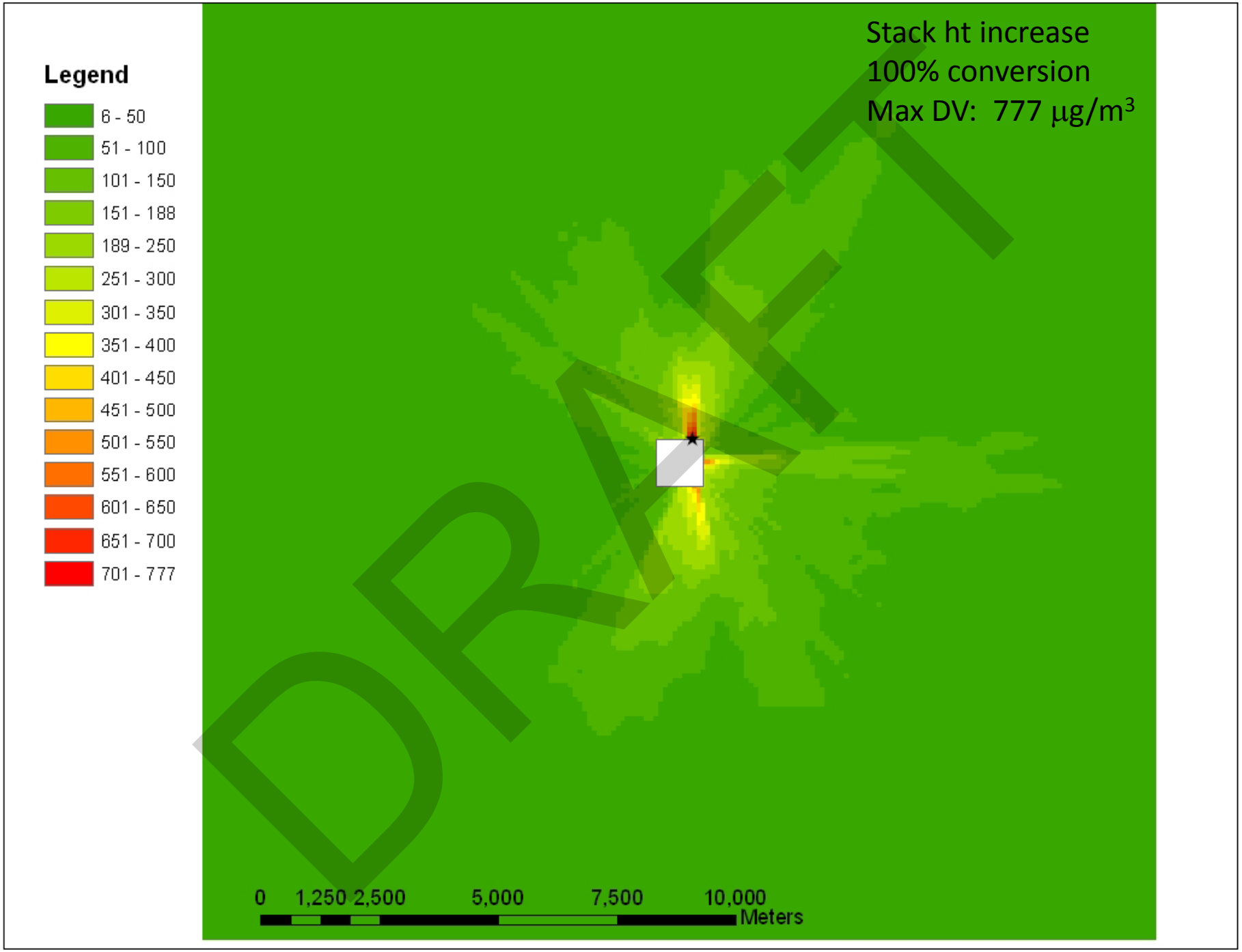

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Base
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

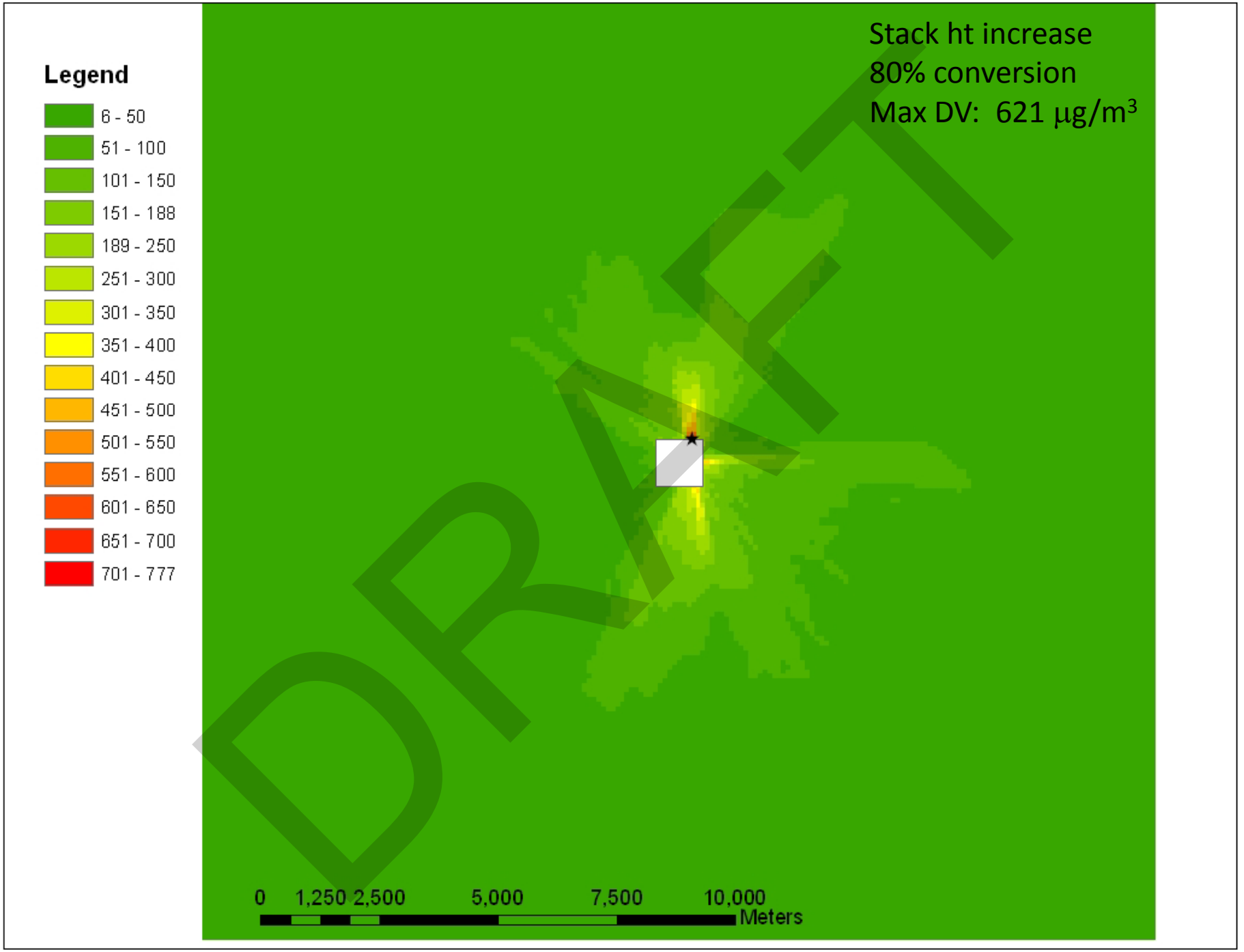

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Base
100% conversion
Max DV: 777 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

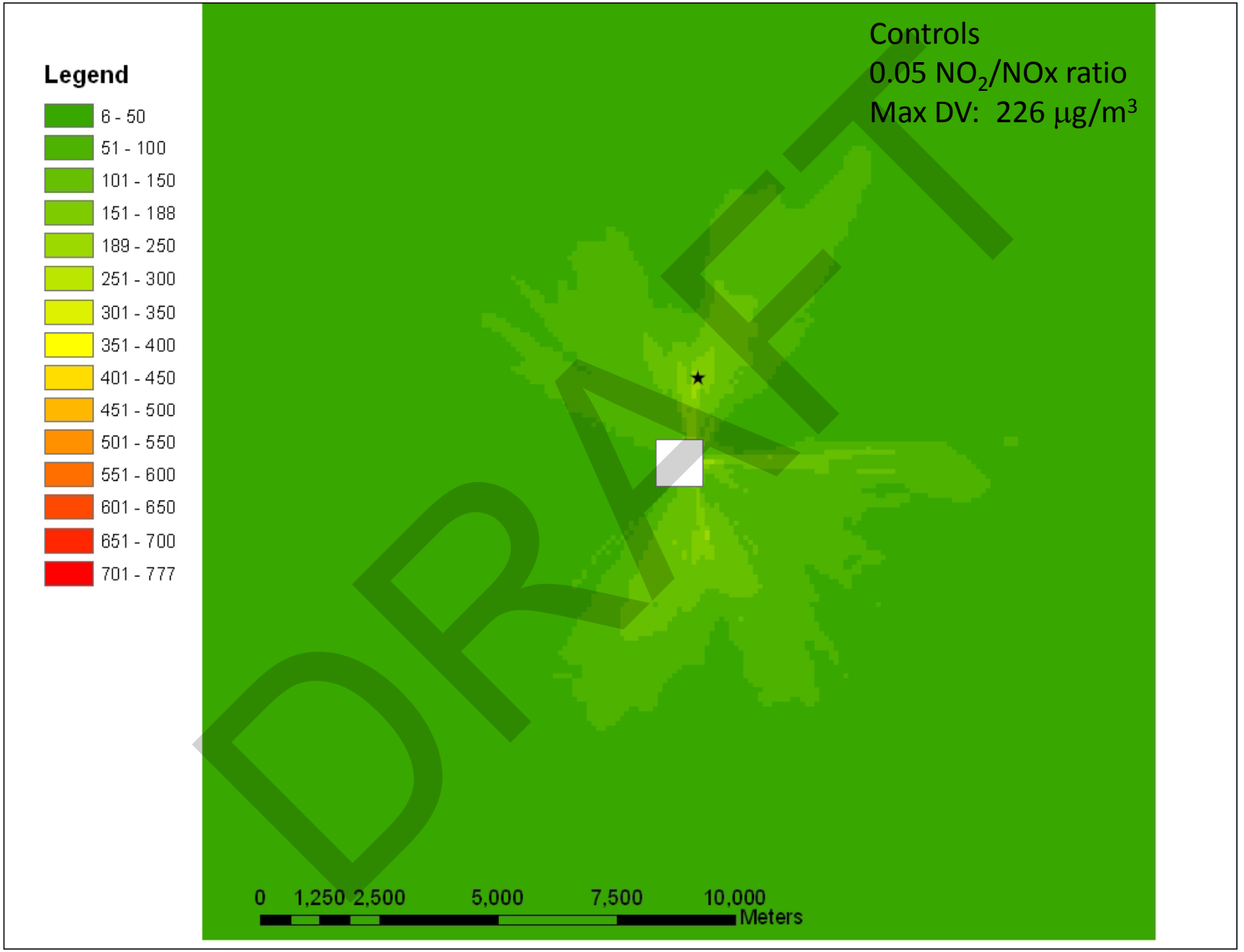

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Base
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

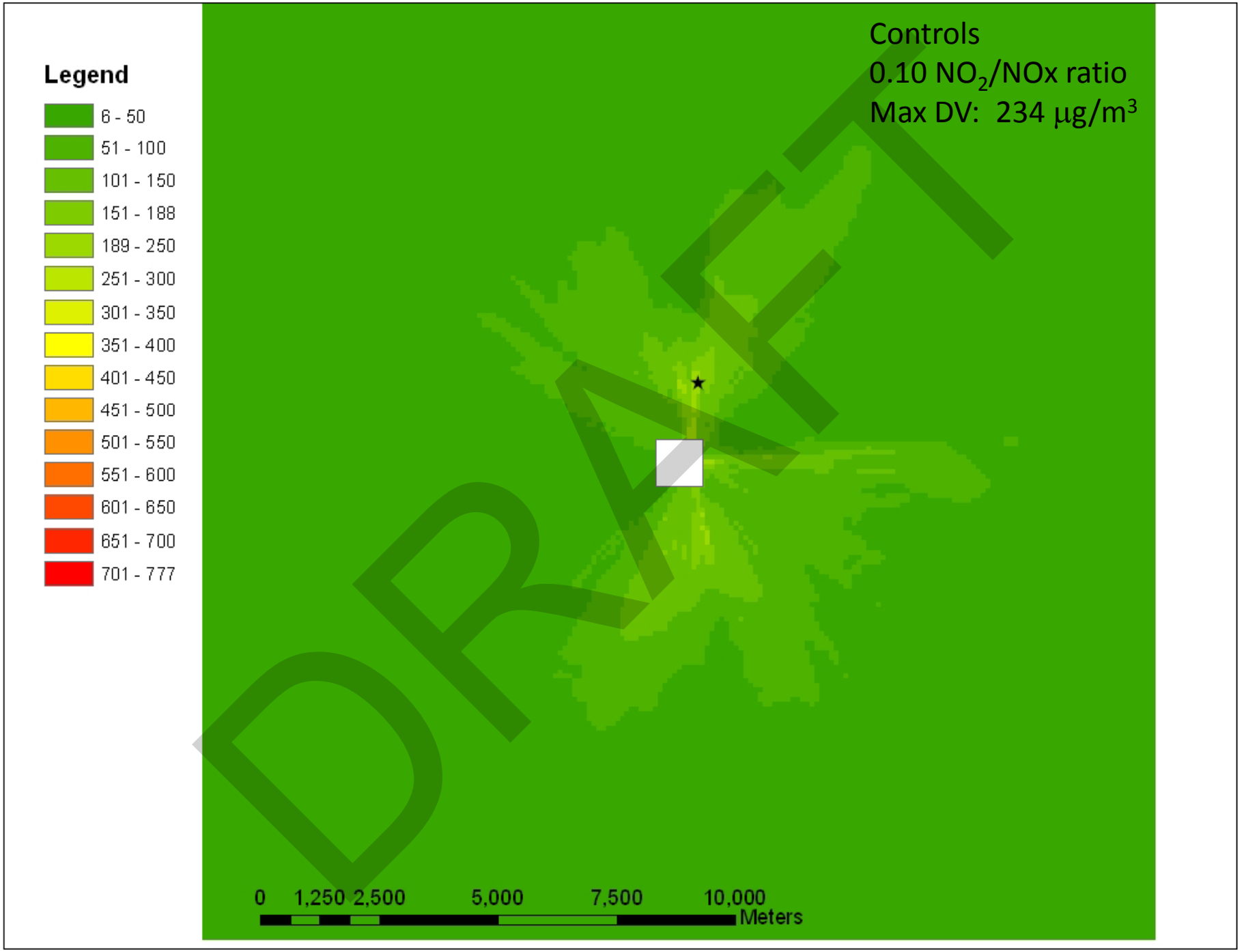

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

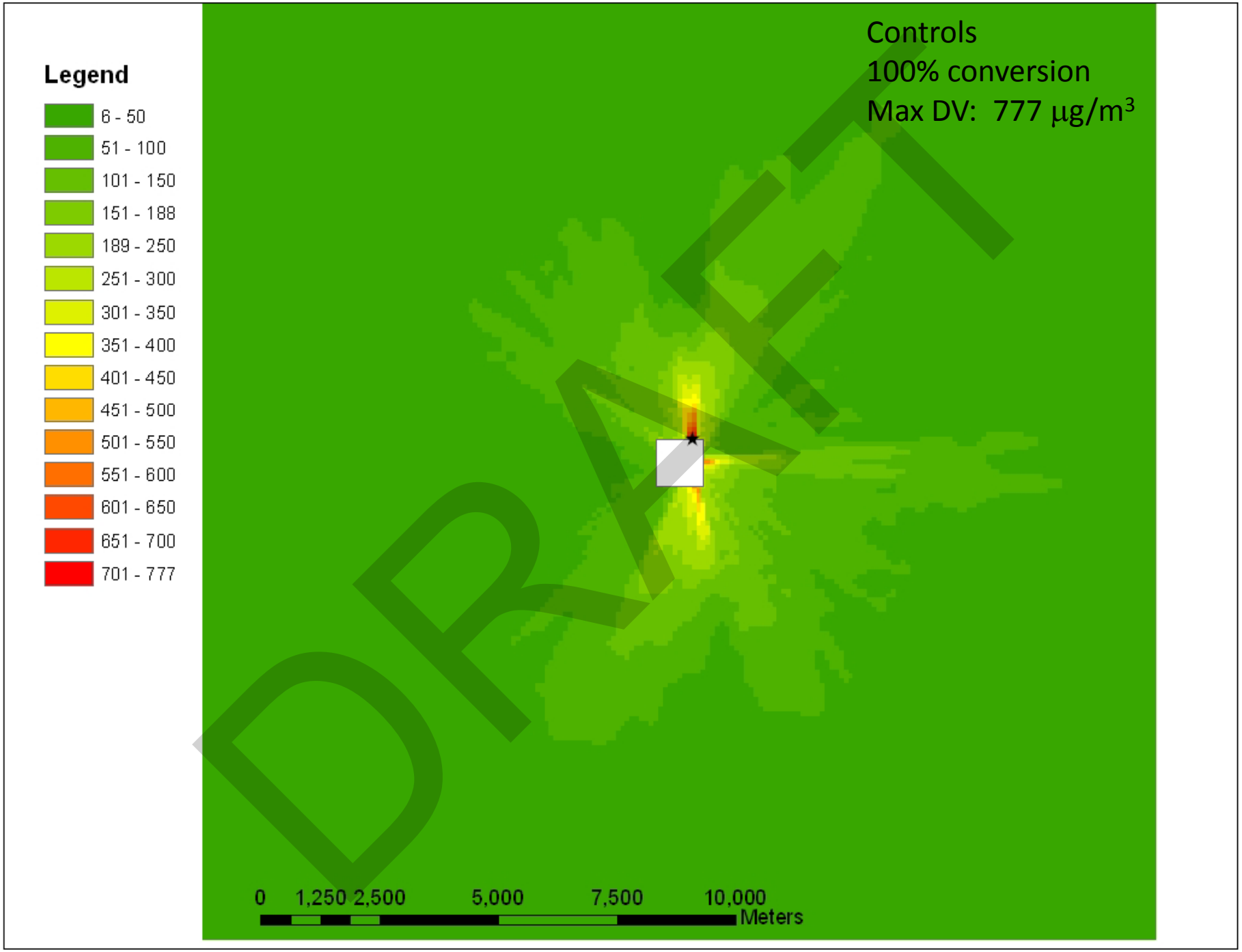

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

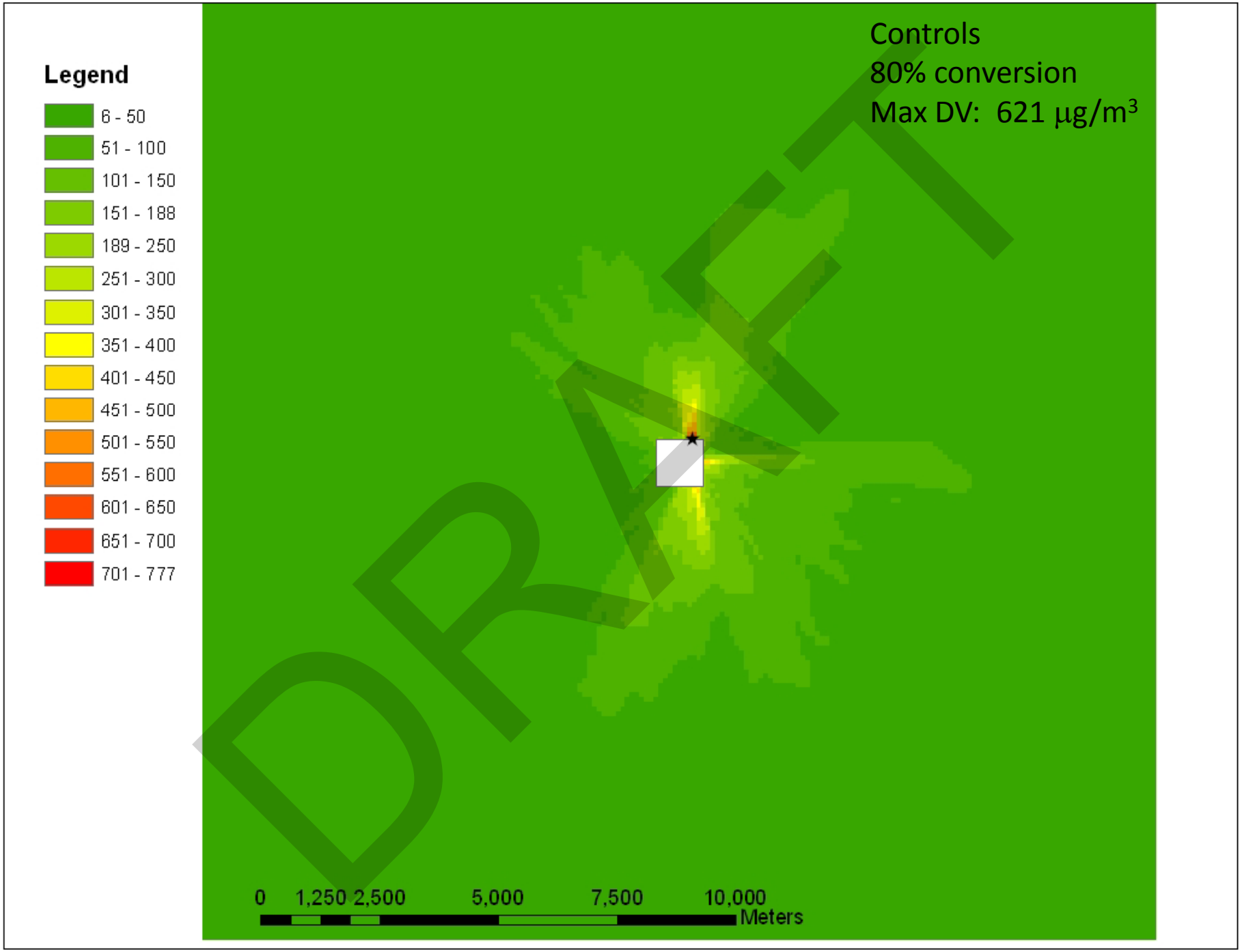

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase
100% conversion
Max DV: 777 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

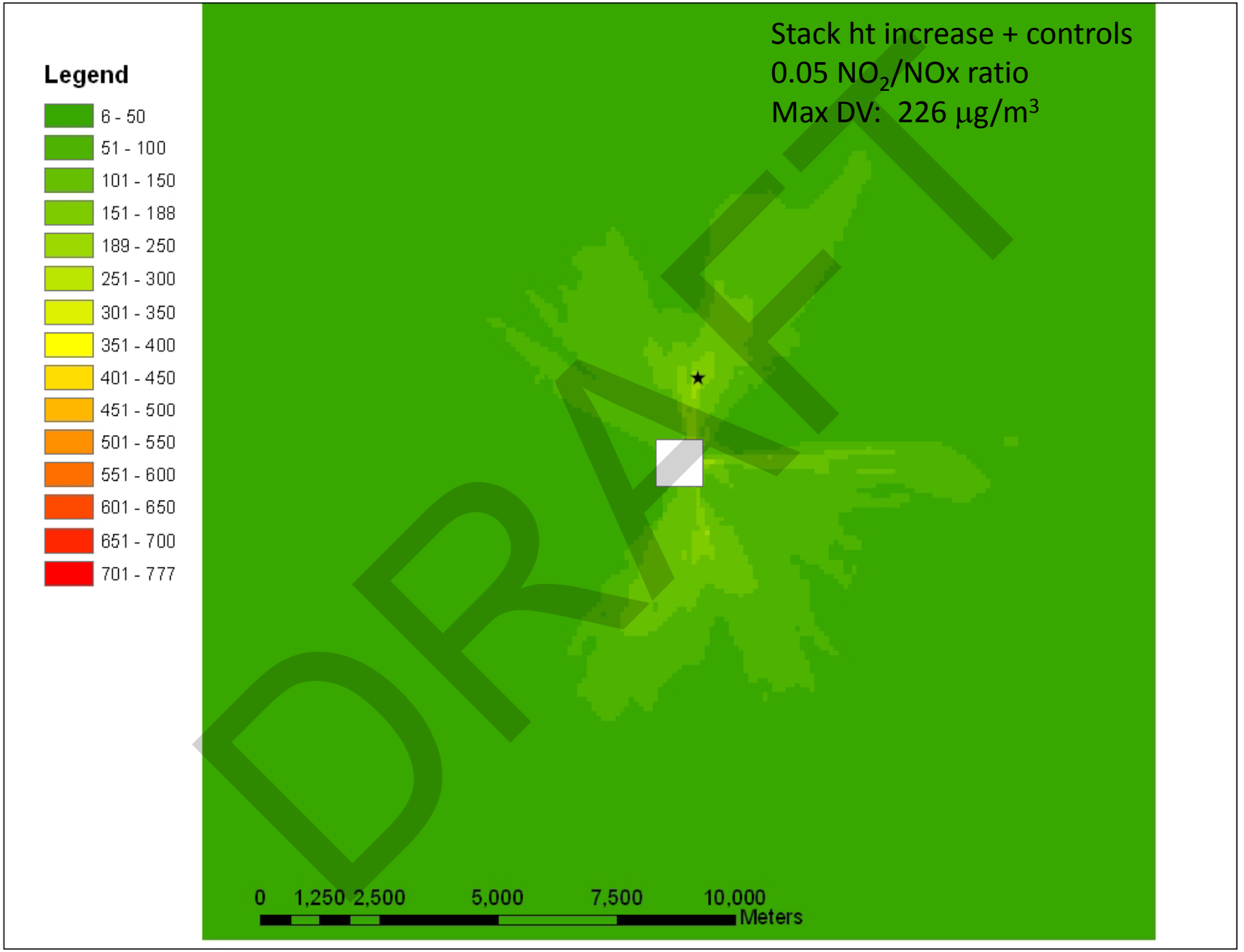

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

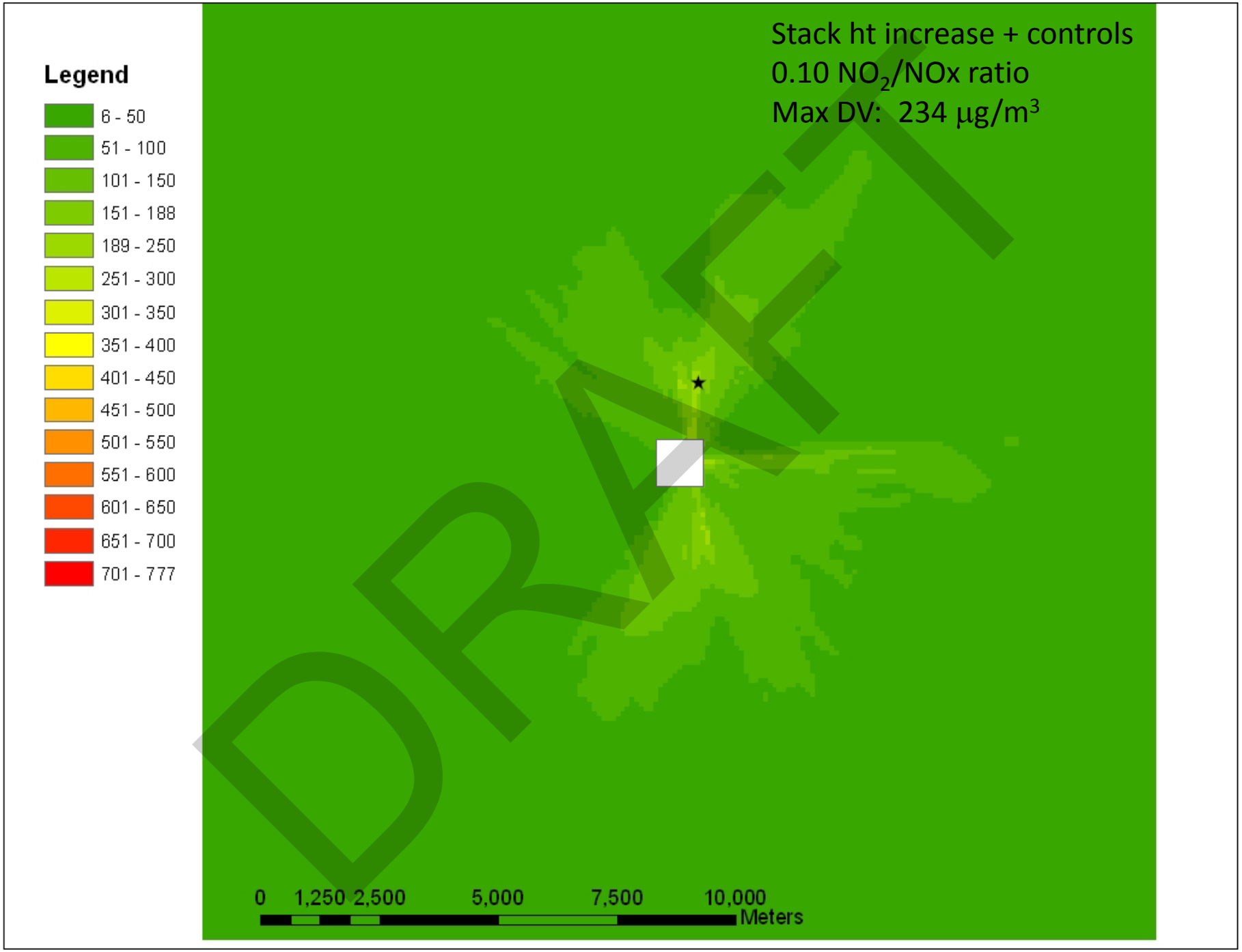

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Controls
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

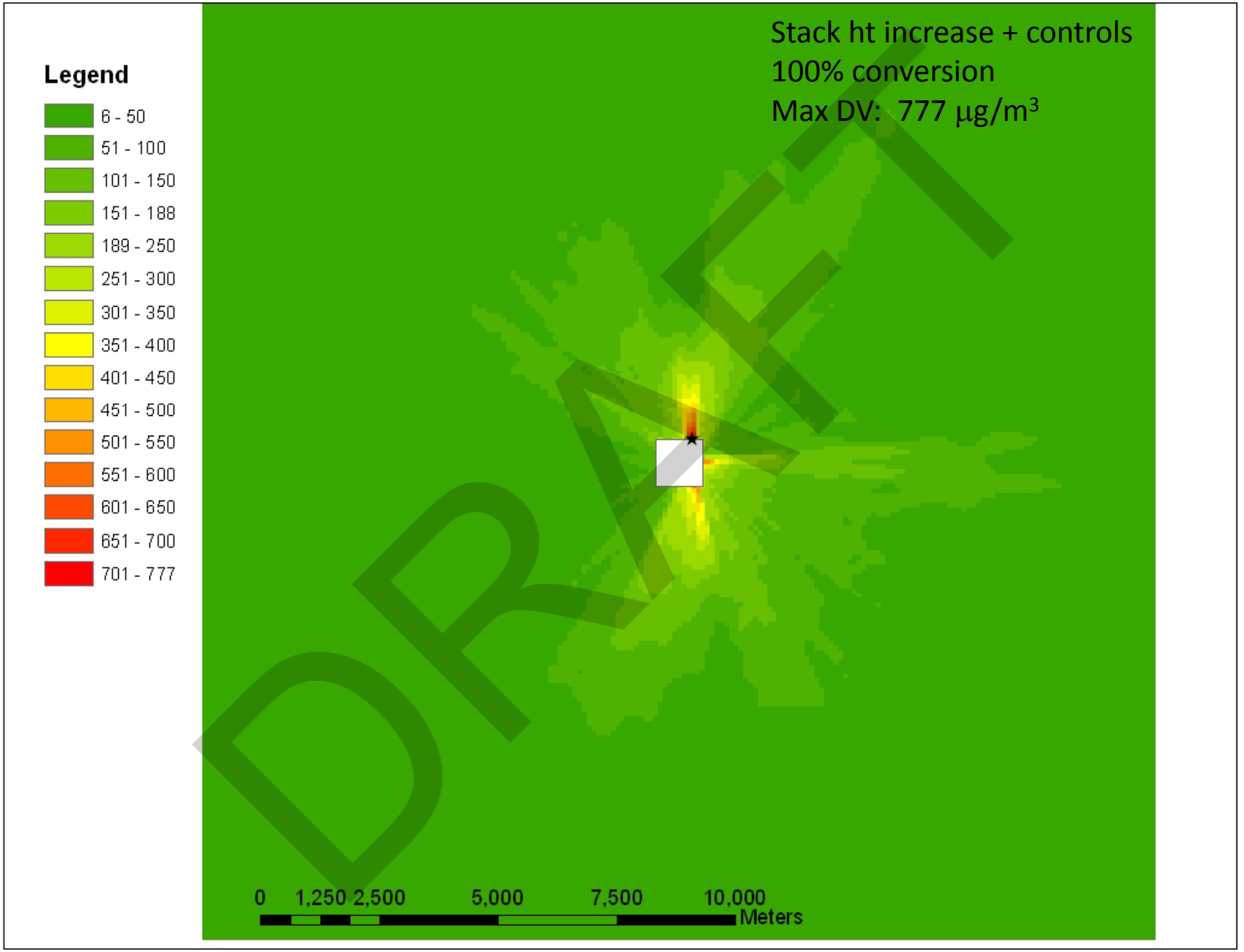

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Controls
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

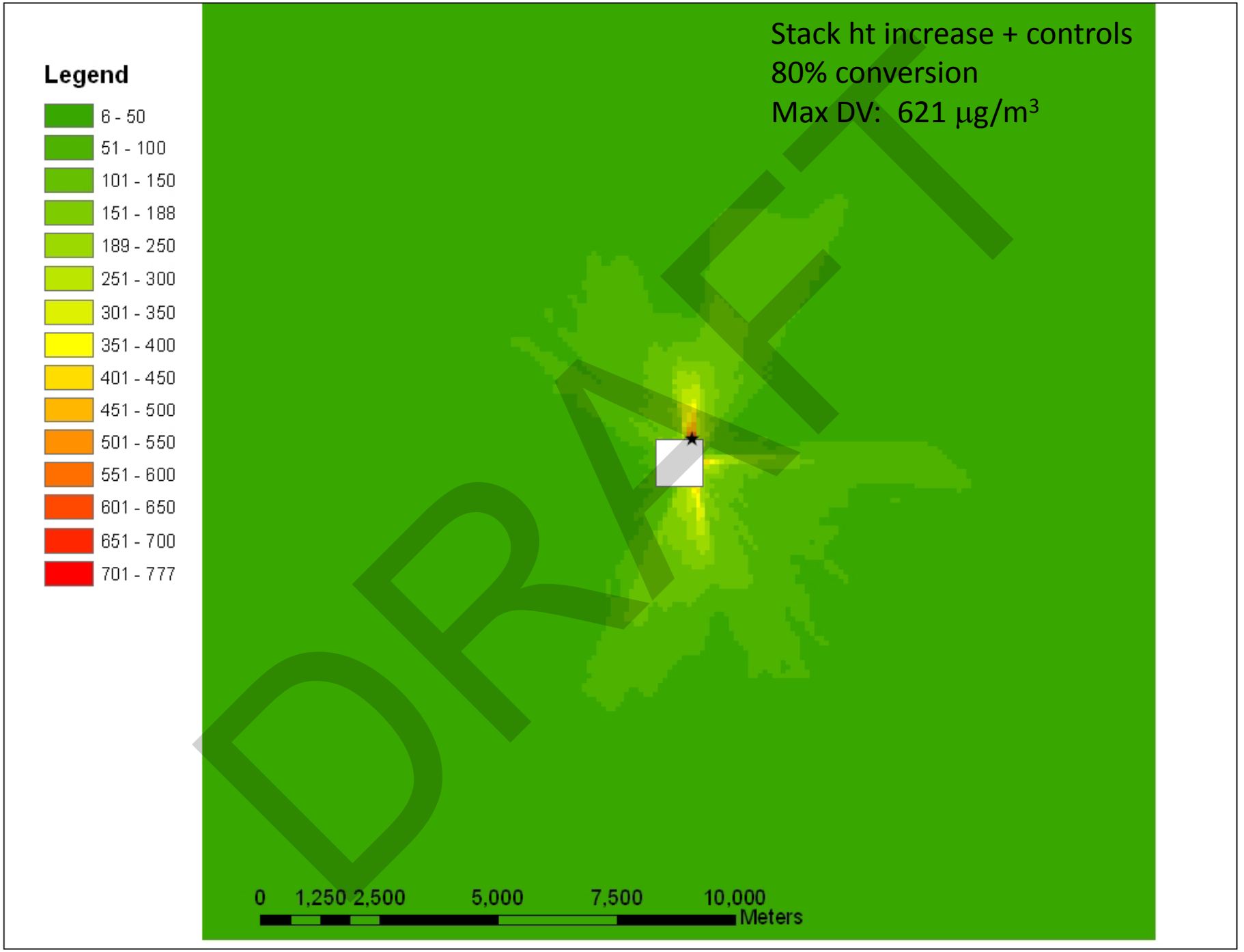

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Controls
100% conversion
Max DV: 777 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

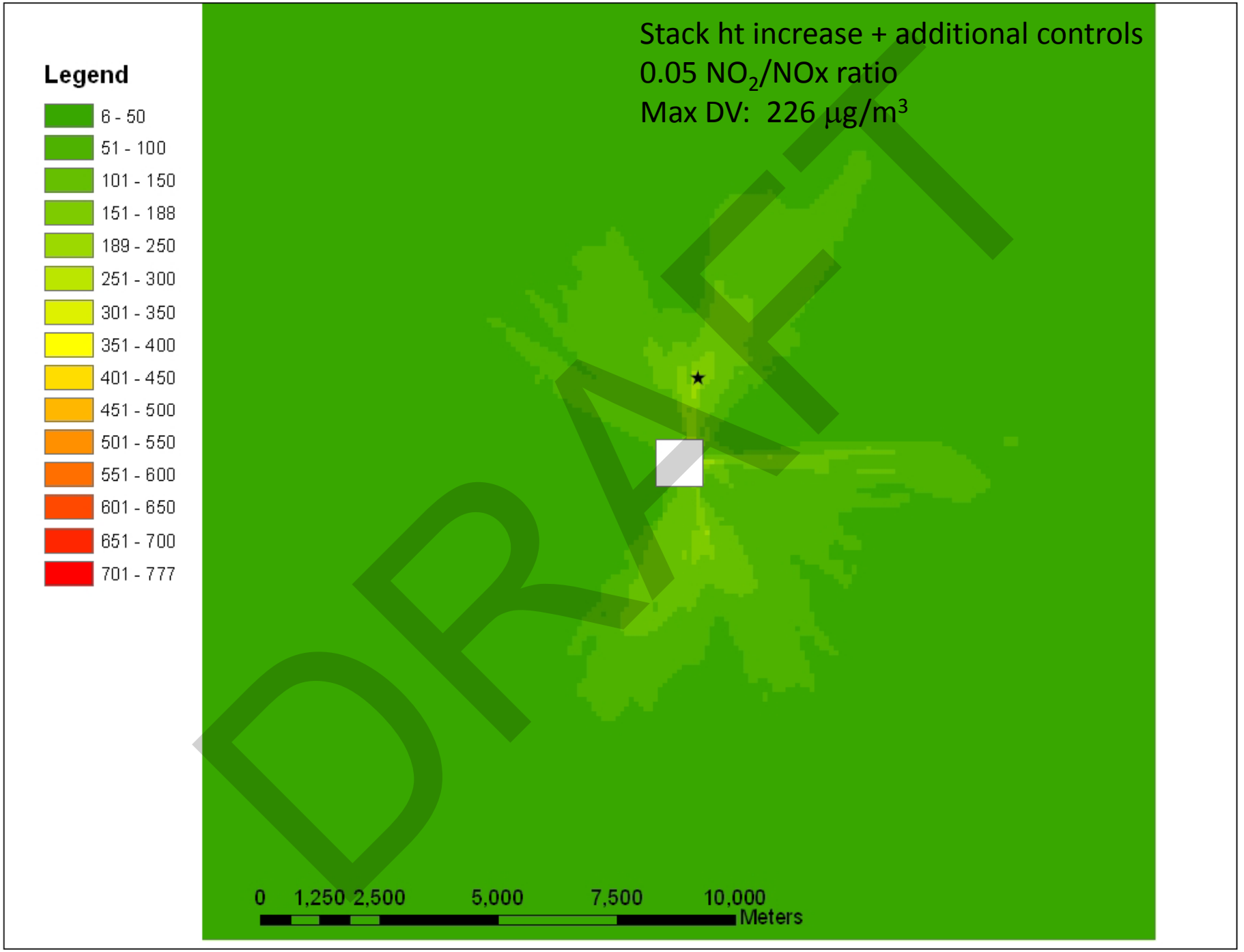

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Controls
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

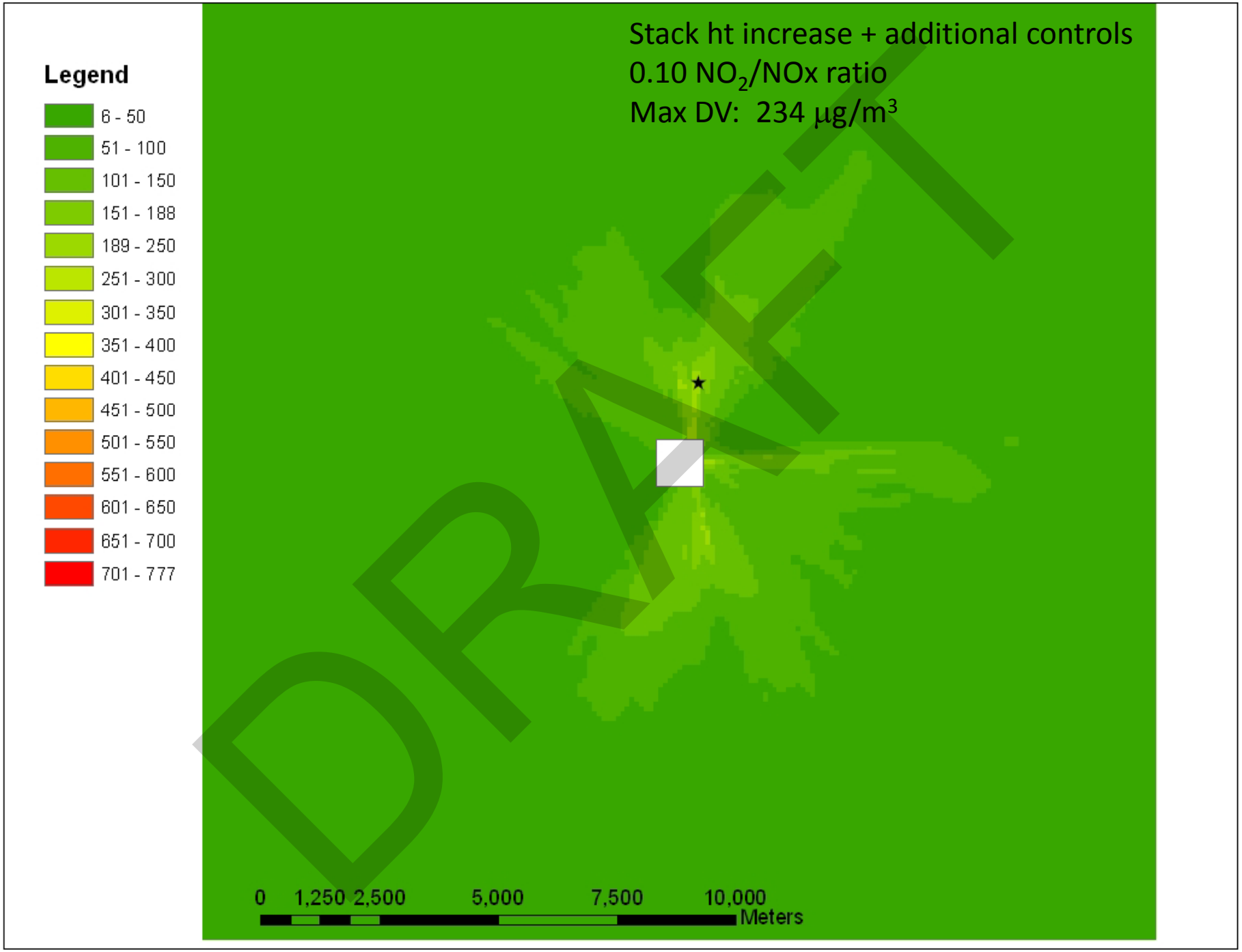

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + controls
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

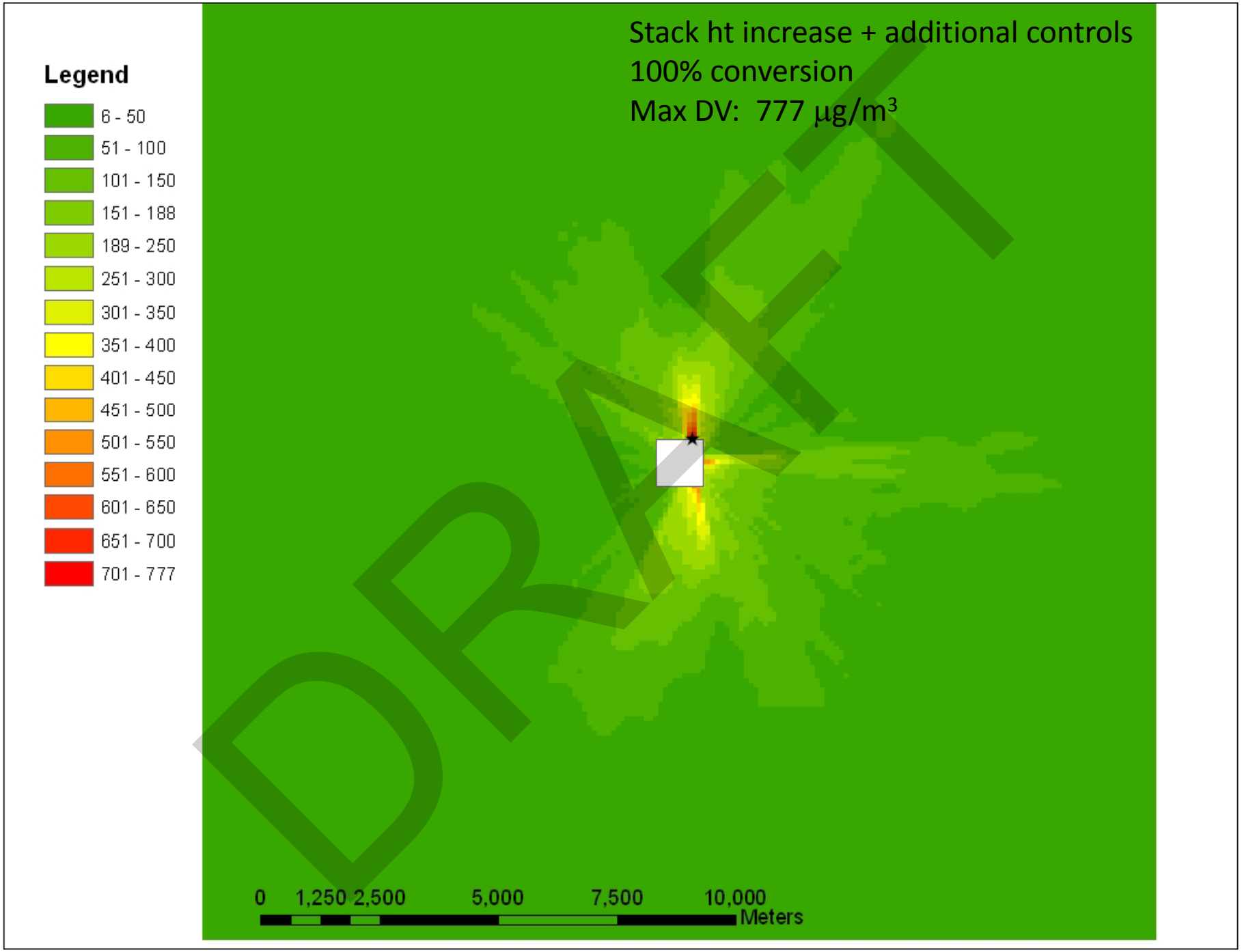

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + controls
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

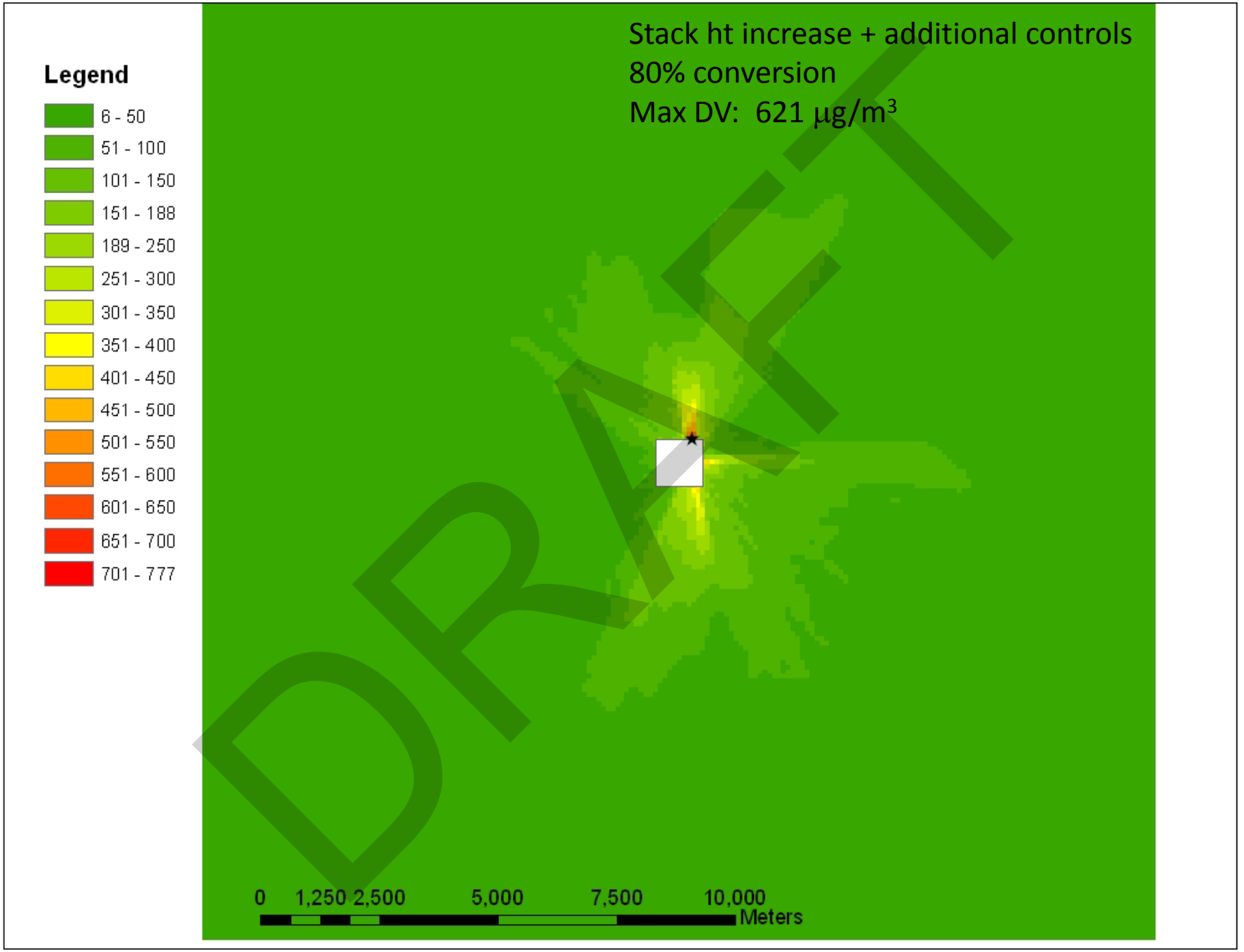

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + controls
100% conversion
Max DV: 777 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

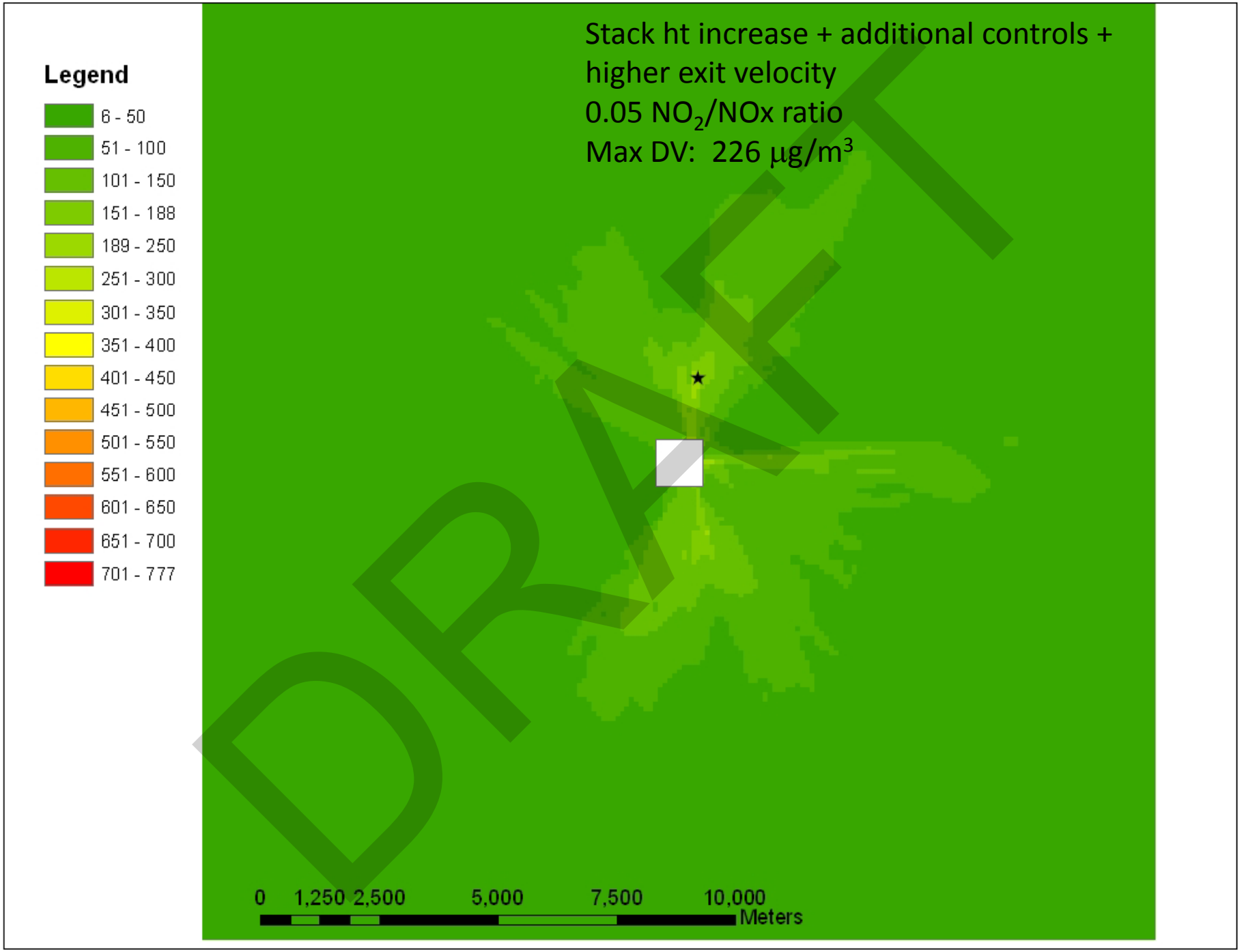

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + controls
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

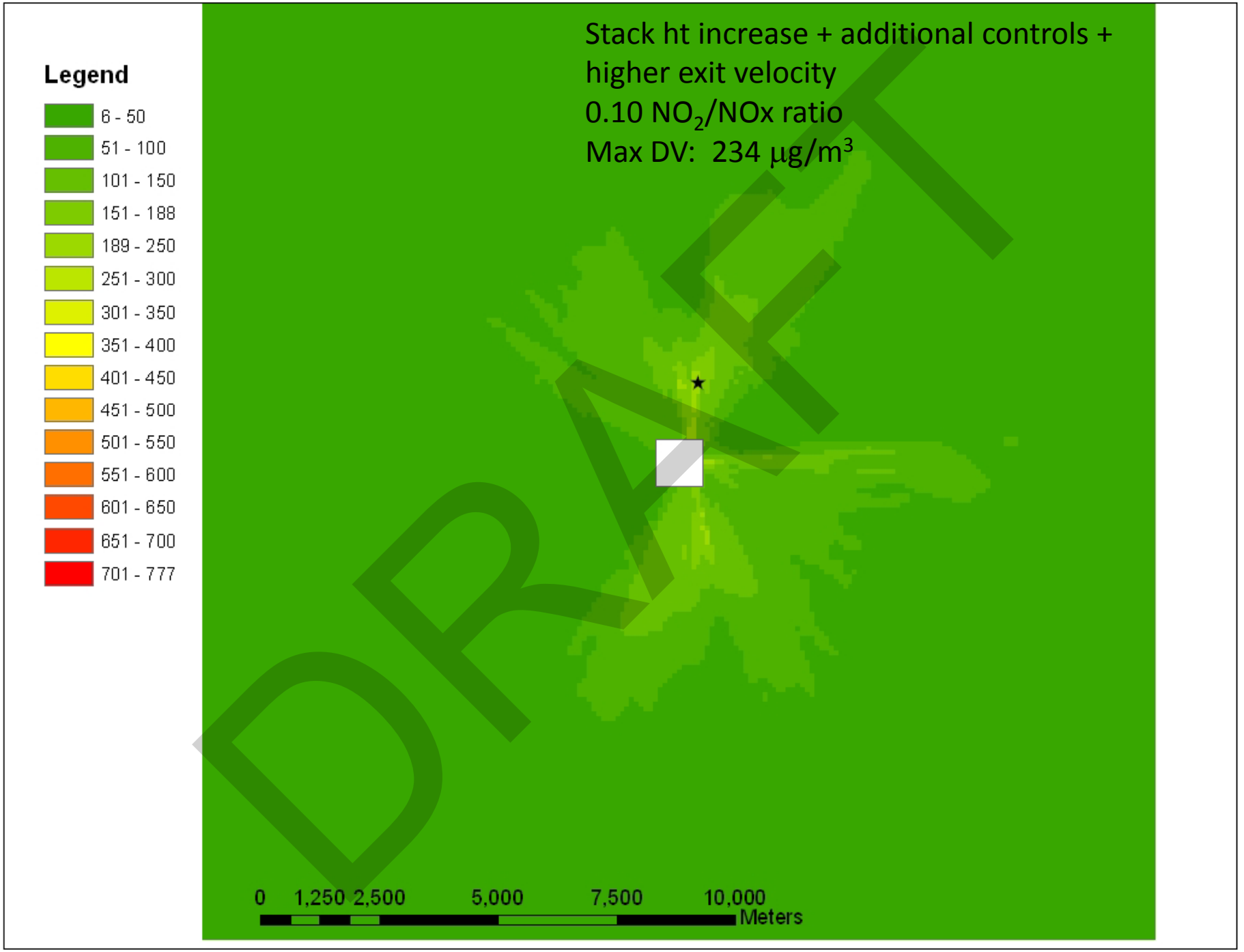

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

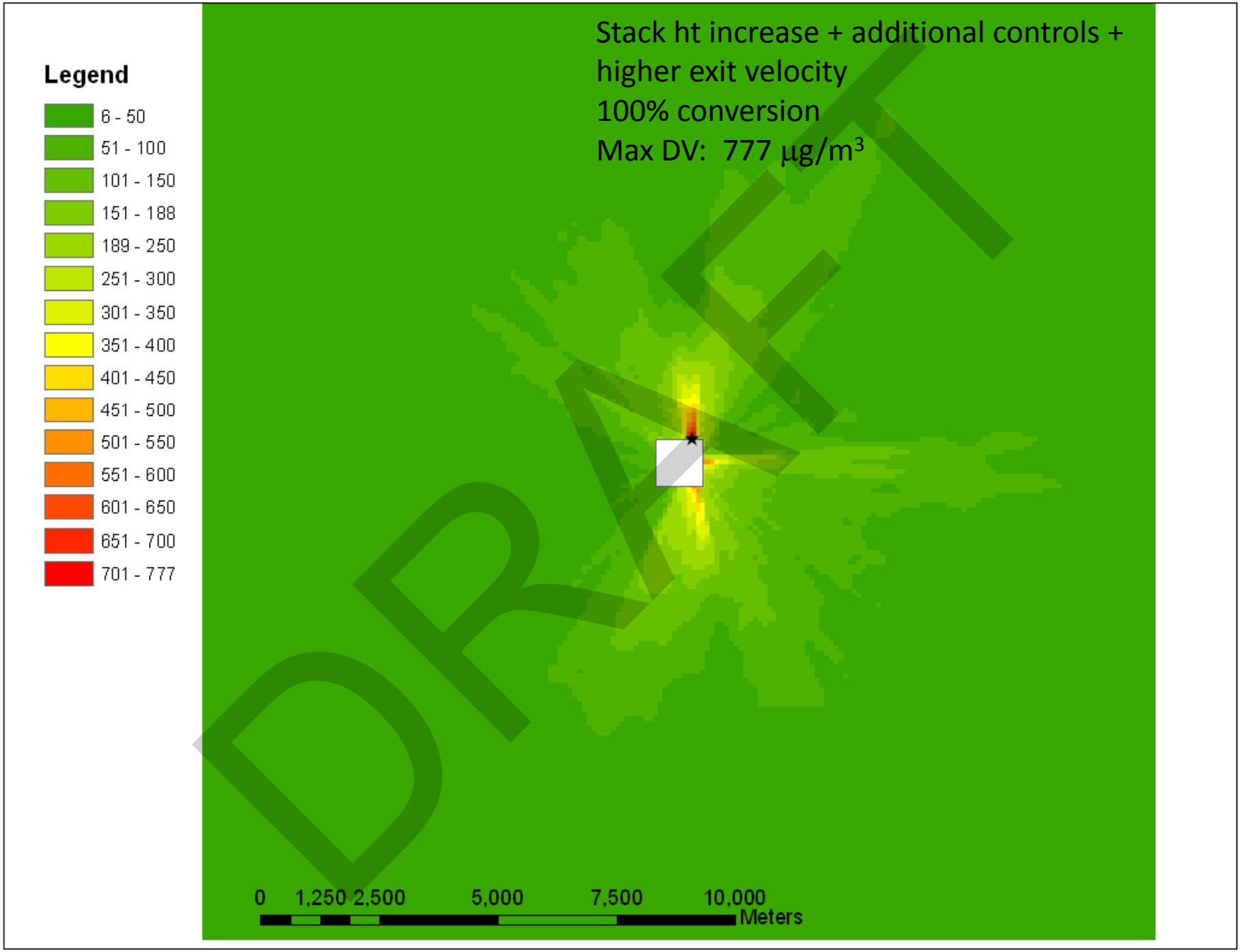

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

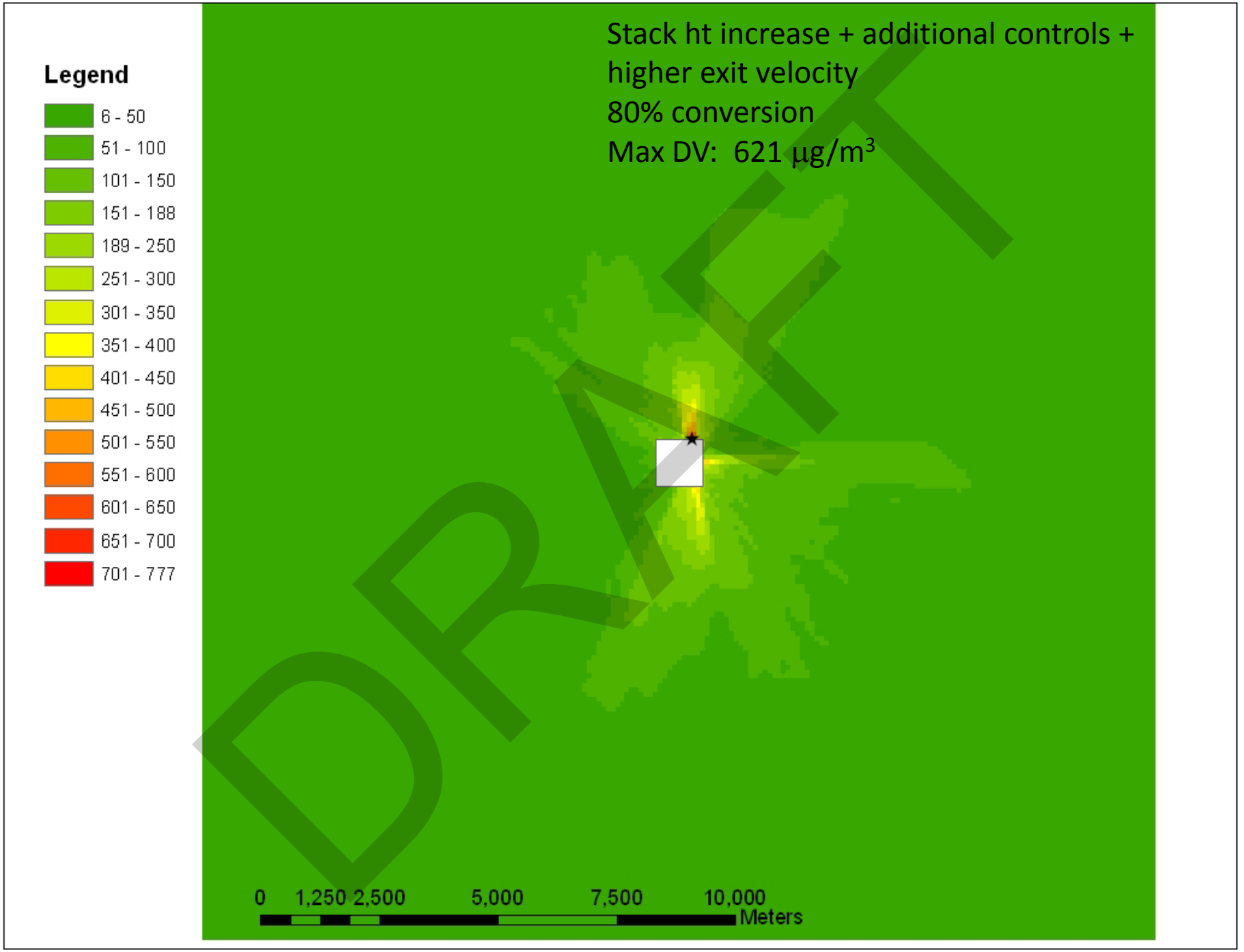

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls
100% conversion
Max DV: 777 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

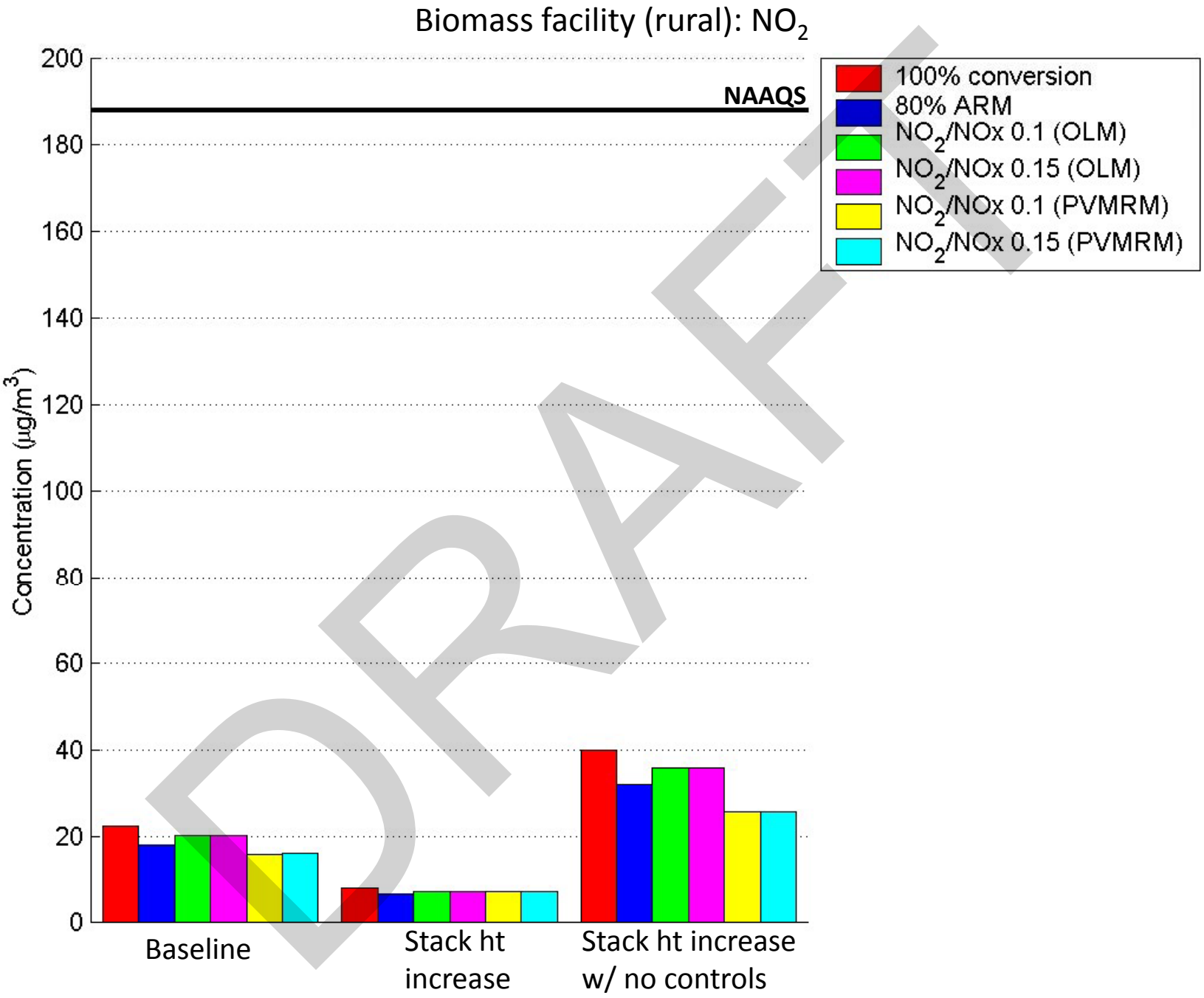

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

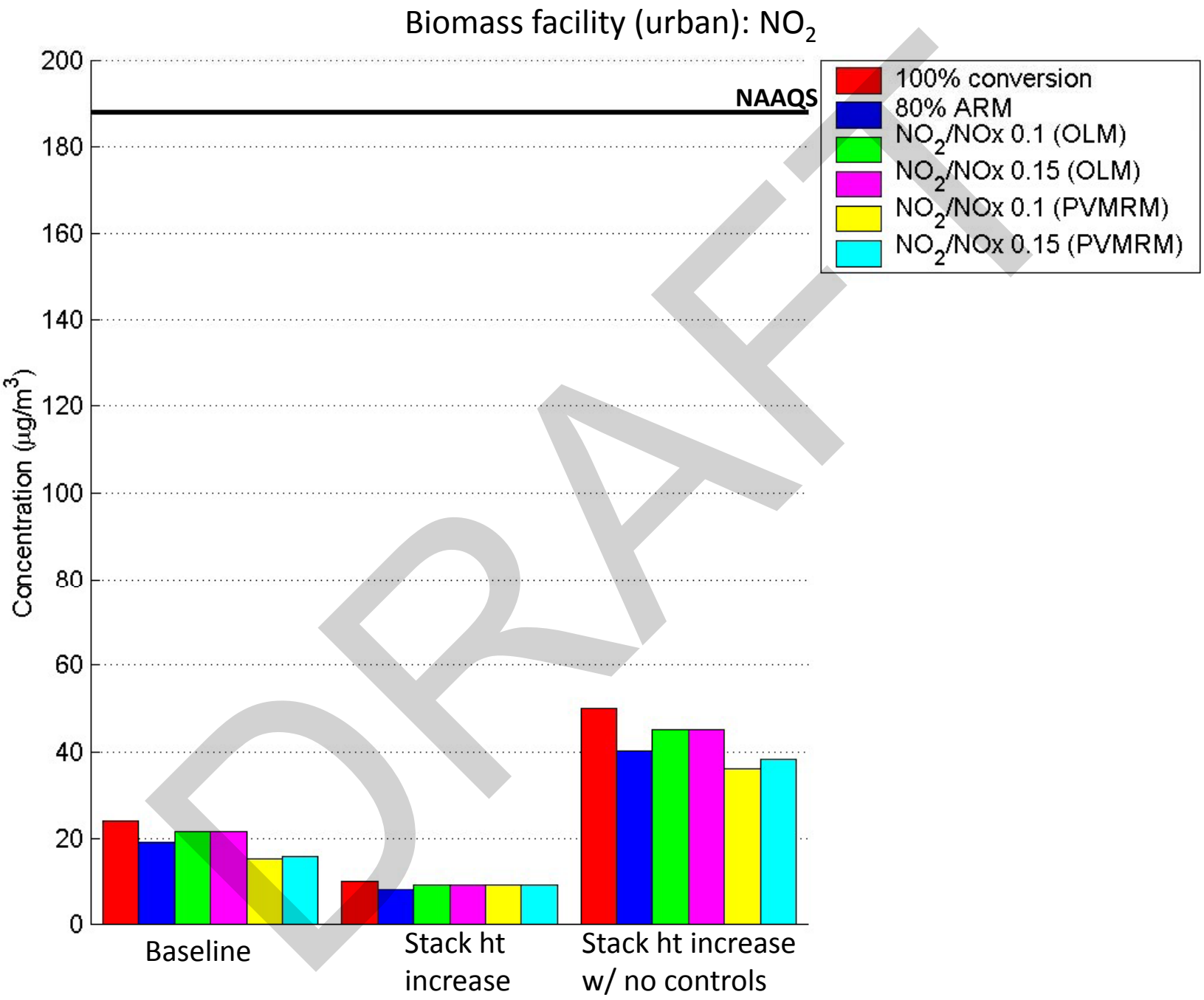

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls +
higher exit velocity
0.05 NO2/NOx ratio
Max DV: 226 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

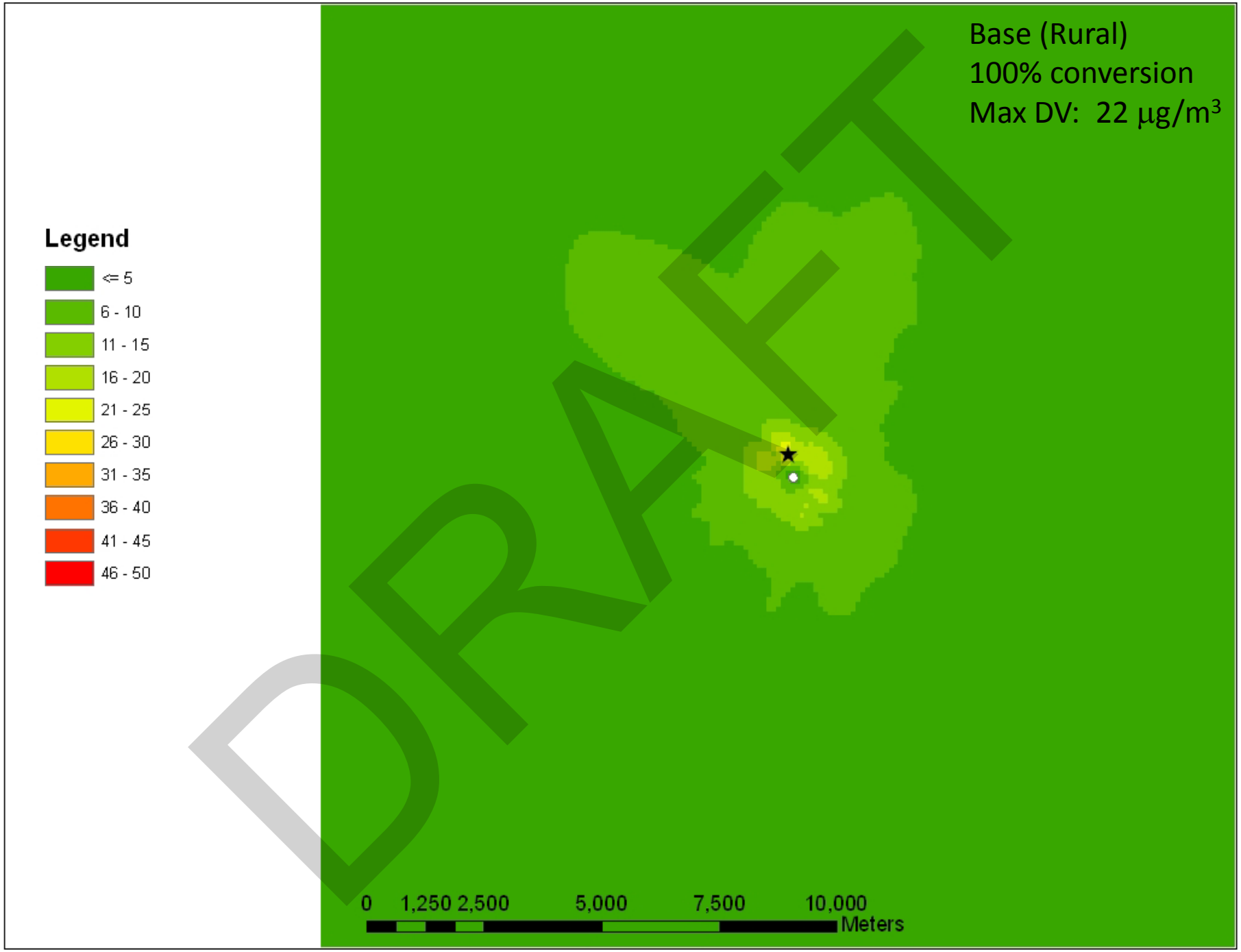

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls +
higher exit velocity
0.10 NO2/NOx ratio
Max DV: 234 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

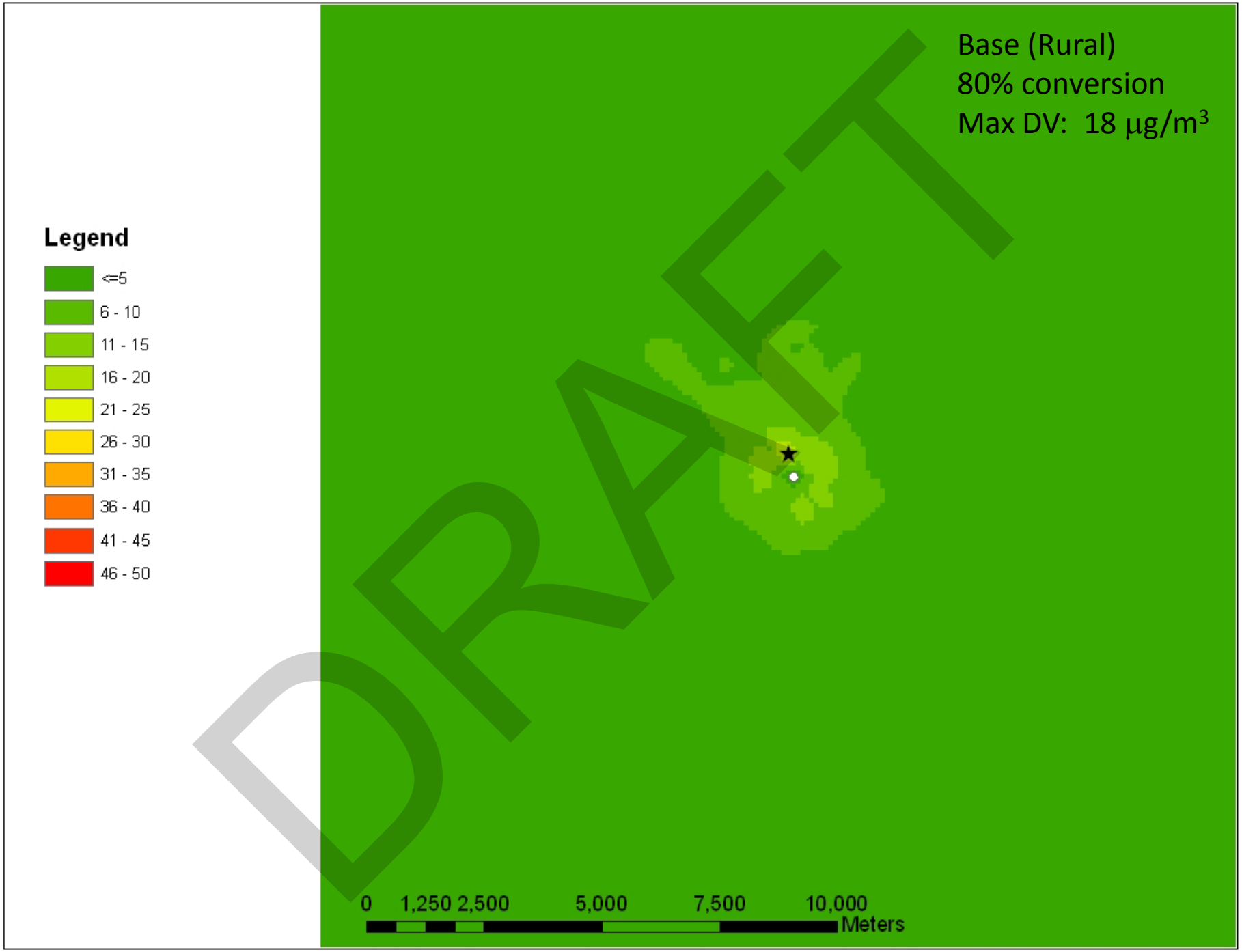

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls +
higher exit velocity
100% conversion
Max DV: 777 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

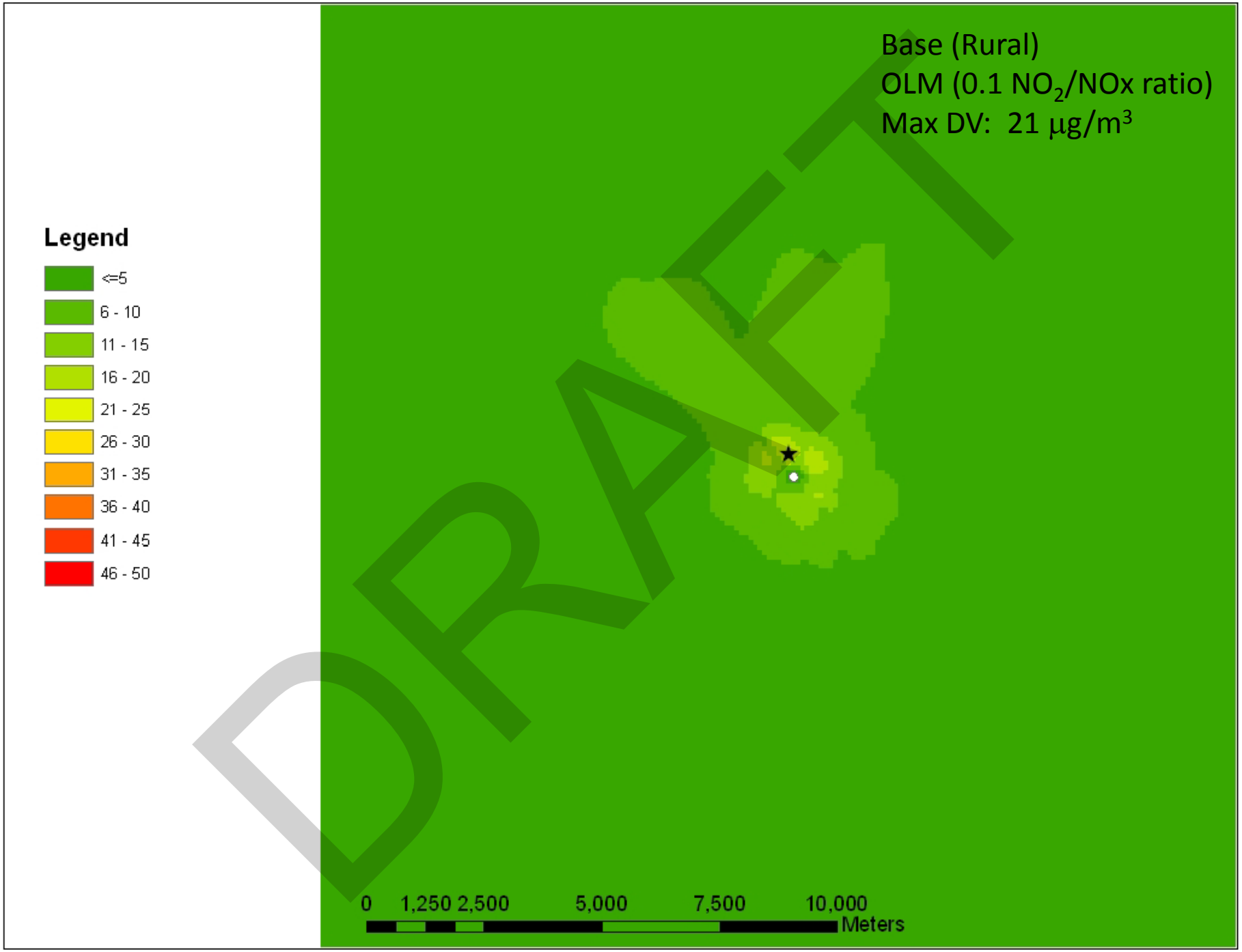

Legend
6 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
551 - 600
601 - 650
651 - 700
701 - 777
Stack ht increase + additional controls +
higher exit velocity
80% conversion
Max DV: 621 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters


Biomass facility (rural): NO2
NAAQS
100% conversion
80% ARM
NO2/NOx 0.1 (OLM)
NO2/NOx 0.15 (OLM)
NO2/NOx 0.1 (PVMRM)
NO2/NOx 0.15 (PVMRM)
Concentration (µg/m3)
200
180
160
140
120
100
80
60
40
20
0
Baseline
Stack ht increase
Stack ht increase w/ no controls

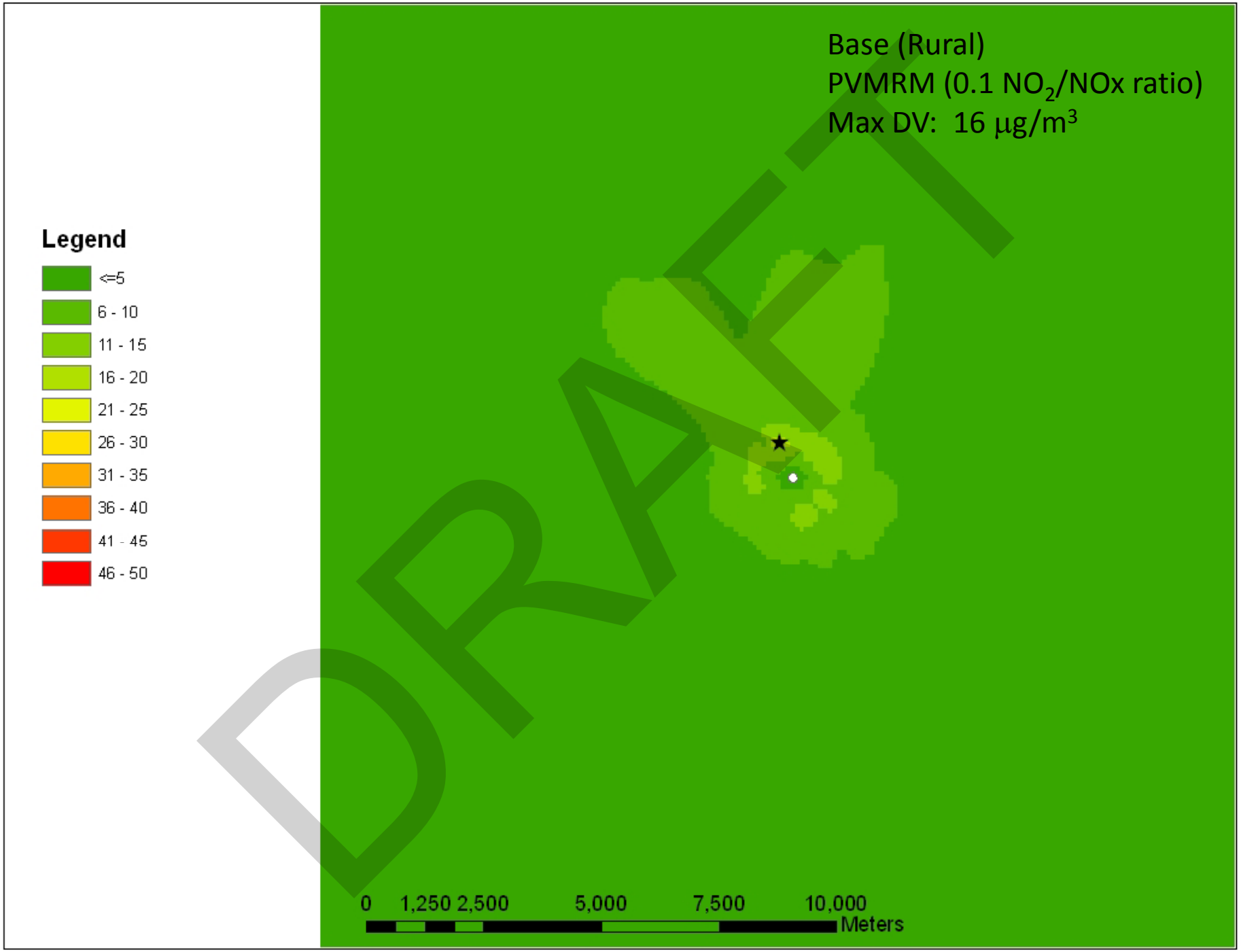

Biomass facility (urban): NO2
NAAQS
100% conversion
80% ARM
NO2/NOx 0.1 (OLM)
NO2/NOx 0.15 (OLM)
NO2/NOx 0.1 (PVMRM)
NO2/NOx 0.15 (PVMRM)
Concentration (µg/m3)
200
180
160
140
120
100
80
60
40
20
0
Baseline
Stack ht increase
Stack ht increase w/ no controls


Base (Rural)
100% conversion
Max DV: 22 µg/m3
Legend
<= 5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

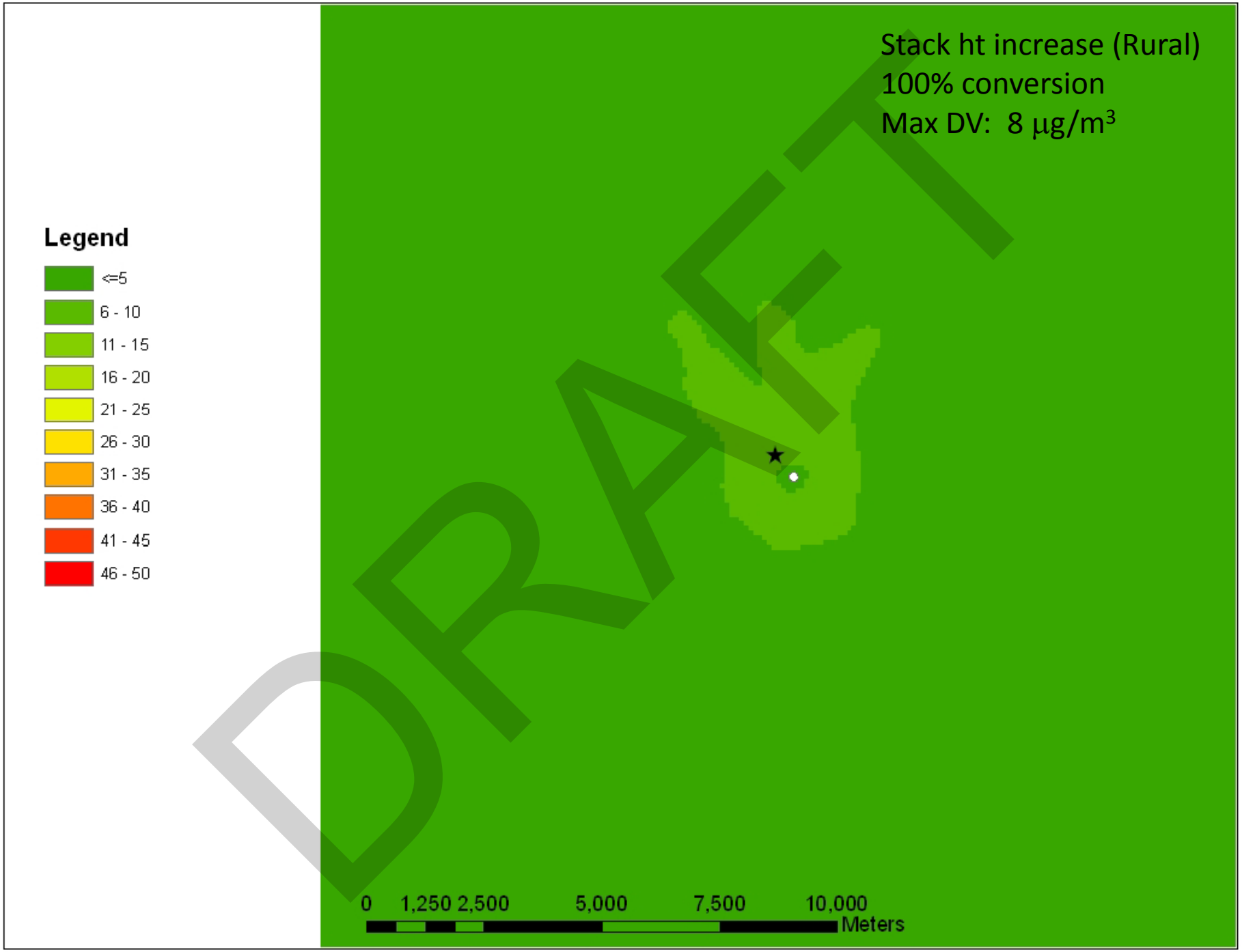

Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
Base (Rural)
80% conversion
Max DV: 18 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

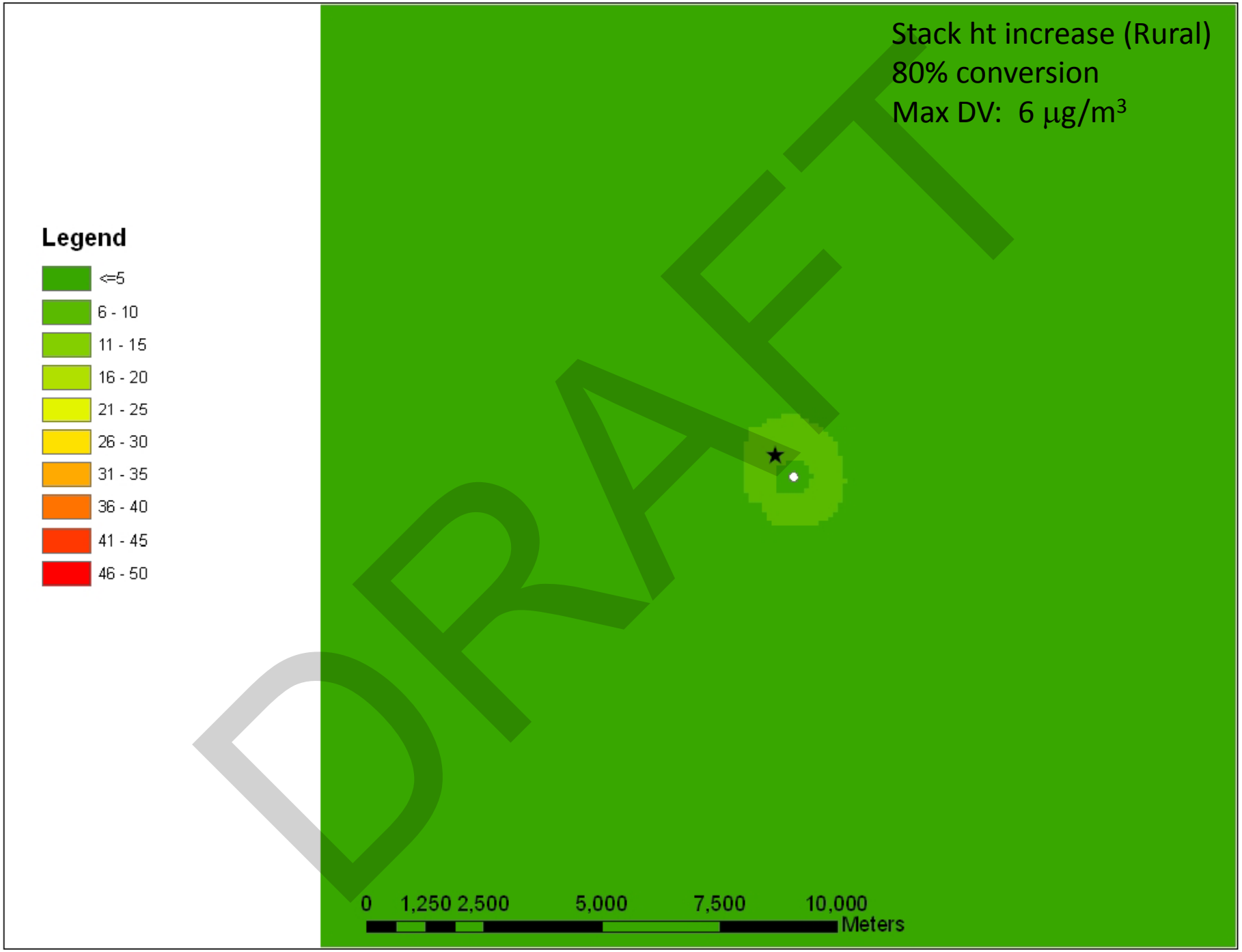

Base (Rural)
OLM (0.1 NO_2/NOx ratio)
Max DV: 21 µg/m^3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

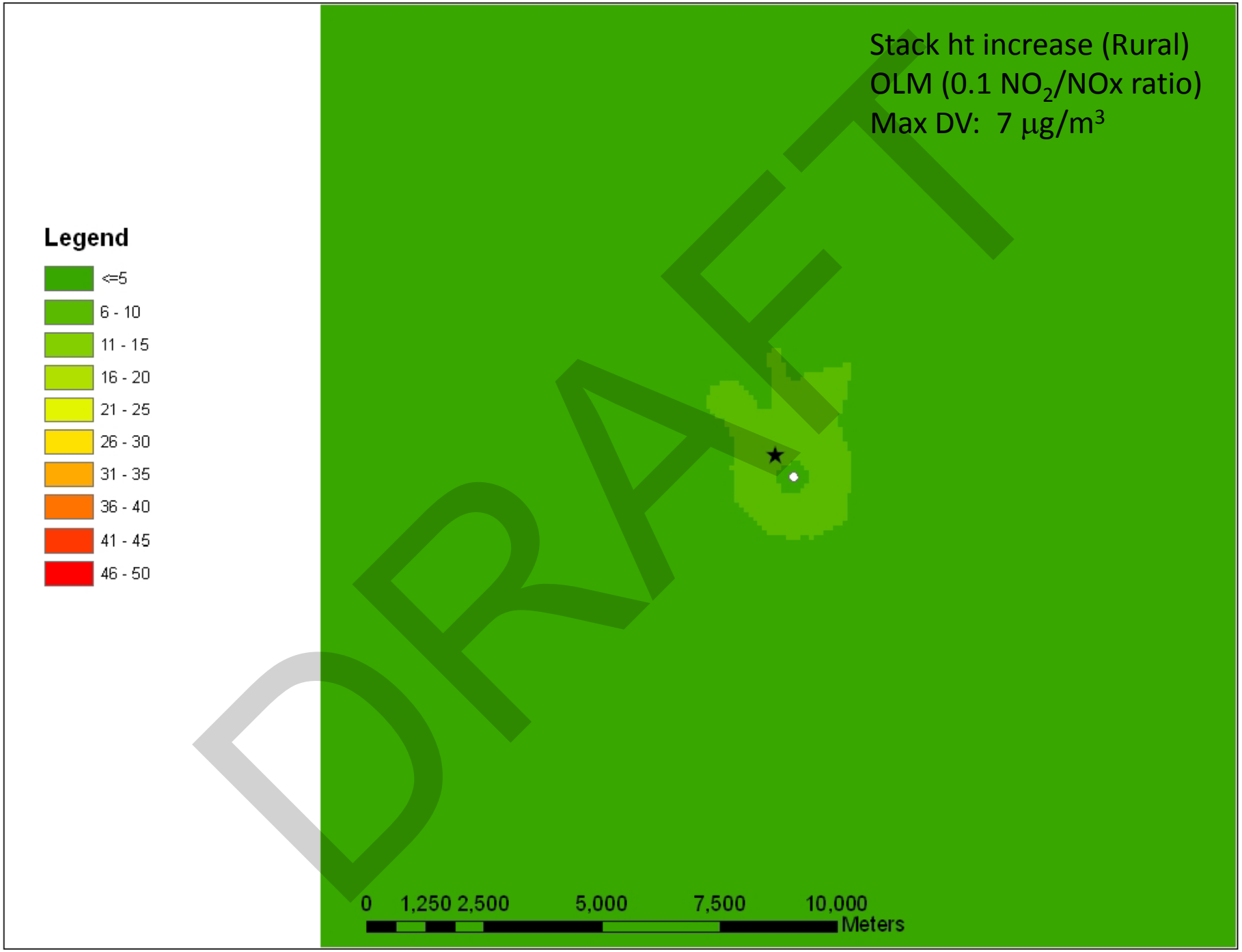

Base (Rural)
OLM (0.15 NO2/NOx ratio)
Max DV: 21 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

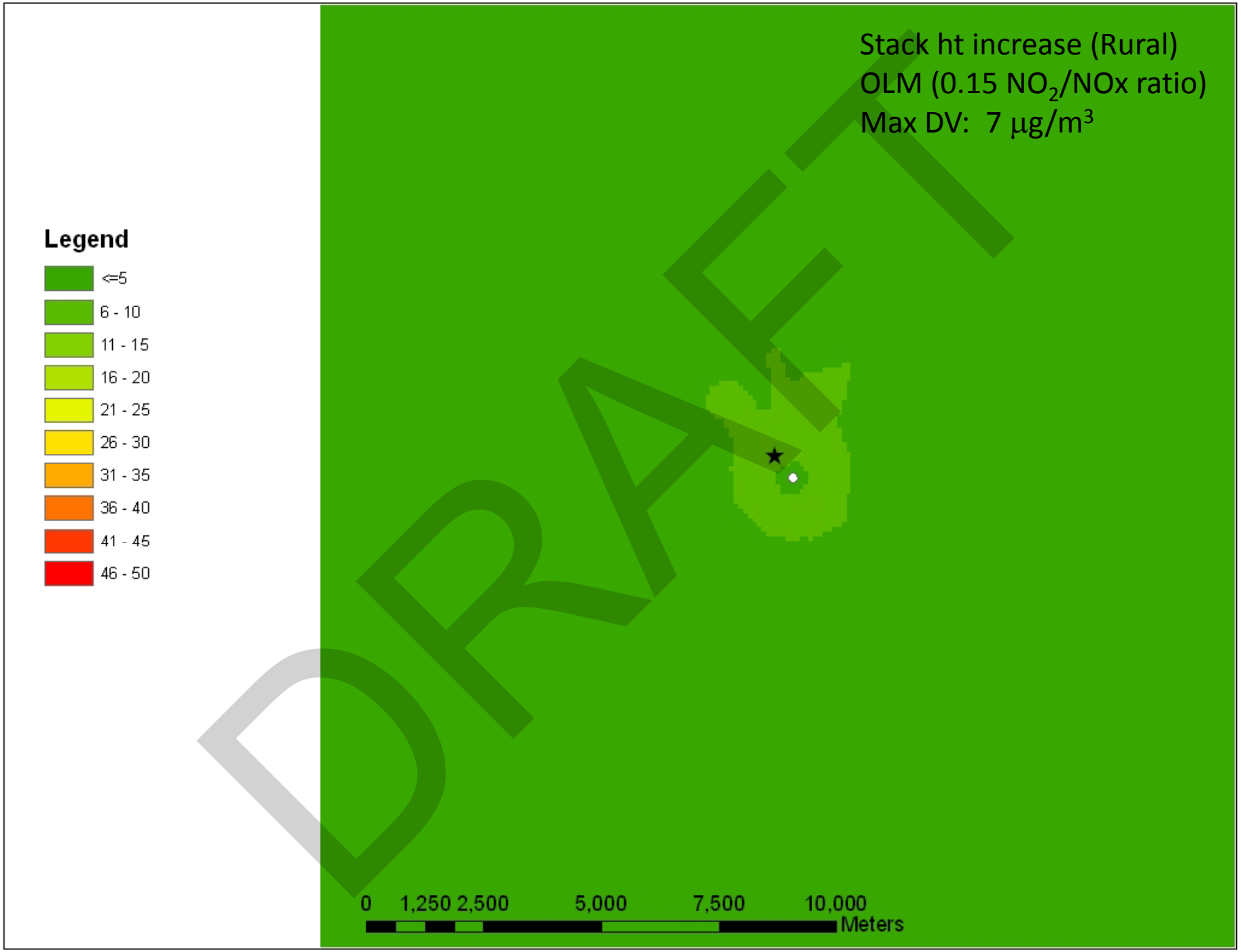

Base (Rural)
PVMRM (0.1 NO2/NOx ratio)
Max DV: 16 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

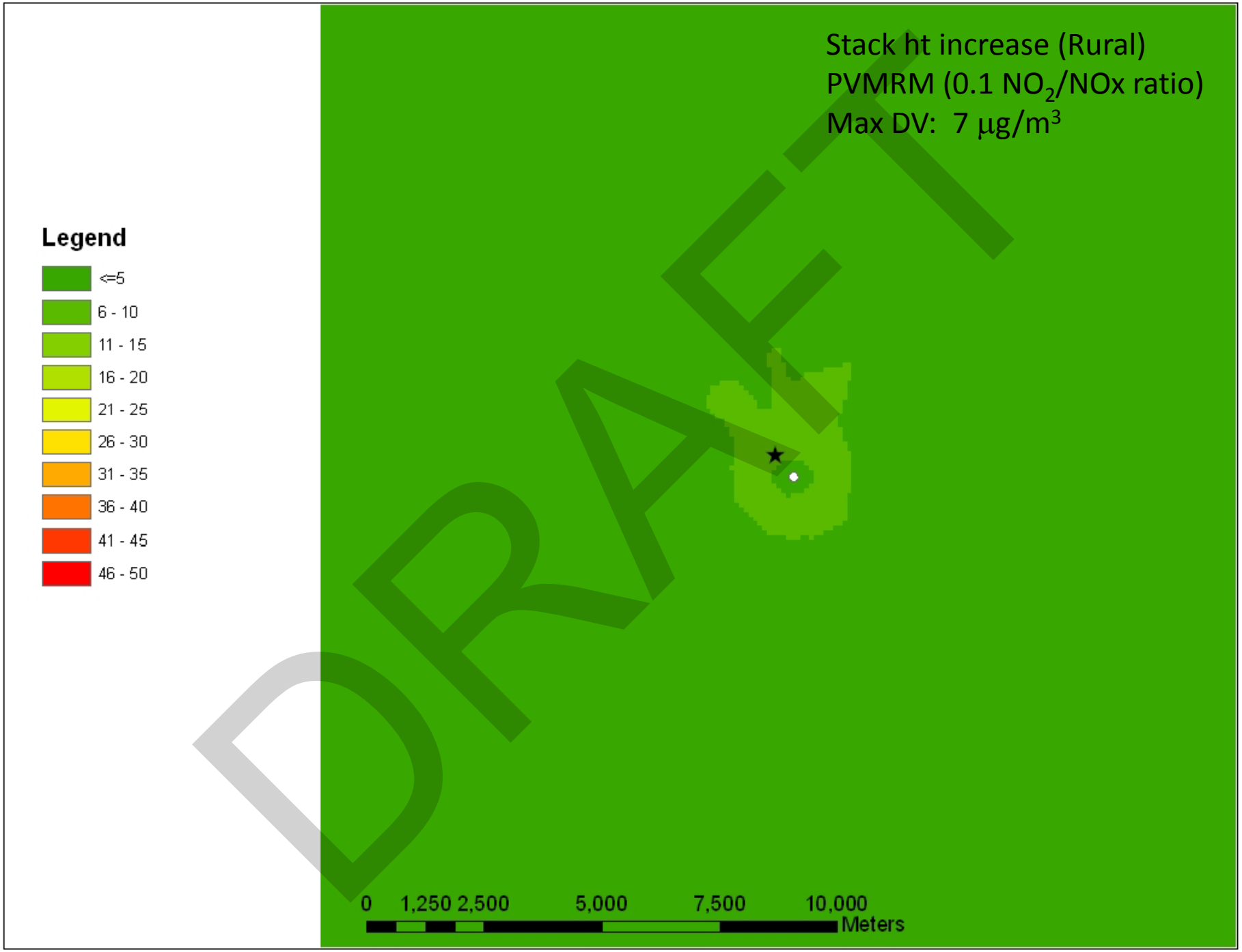

Base (Rural)
PVMRM (0.15 NO_2/NOx ratio)
Max DV: 16 µg/m^3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

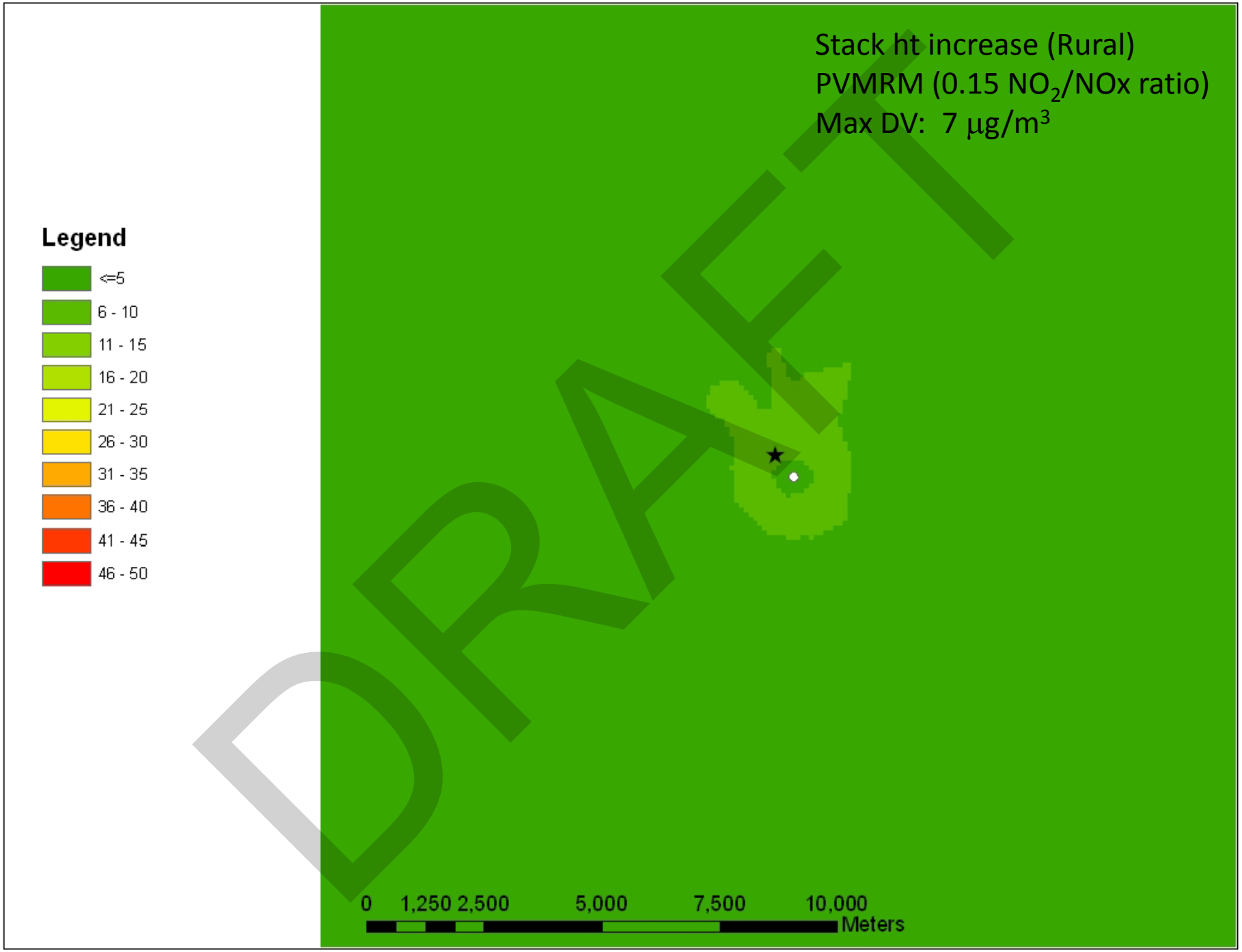

Stack ht increase (Rural)
100% conversion
Max DV: 8 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

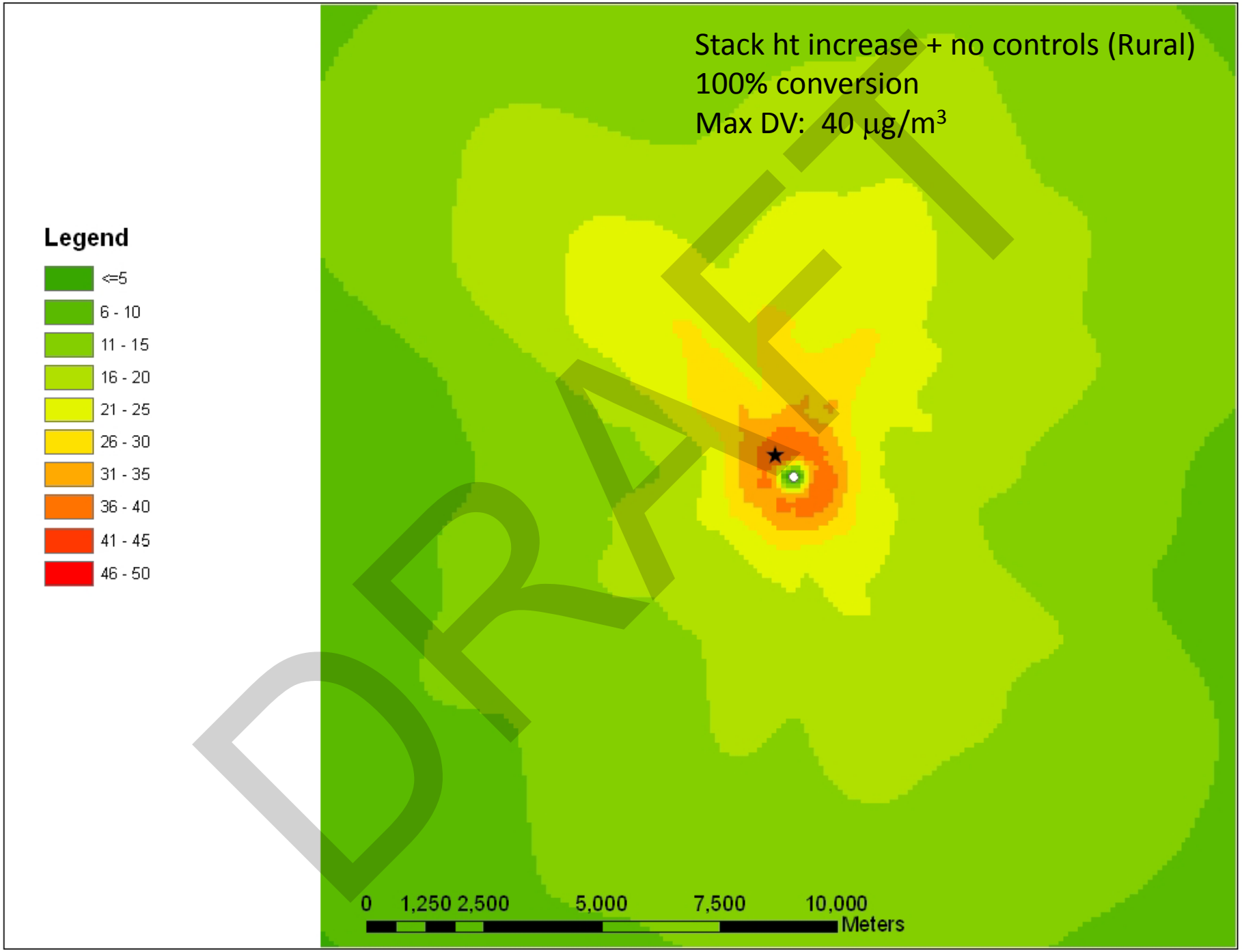

Stack ht increase (Rural)
80% conversion
Max DV: 6 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase (Rural)
OLM (0.1 NO2/NOx ratio)
Max DV: 7 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase (Rural)
OLM (0.15 NO2/NOx ratio)
Max DV: 7 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase (Rural)
PVMRM (0.1 NO2/NOx ratio)
Max DV: 7 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase (Rural)
PVMRM (0.15 NO2/NOx ratio)
Max DV: 7 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

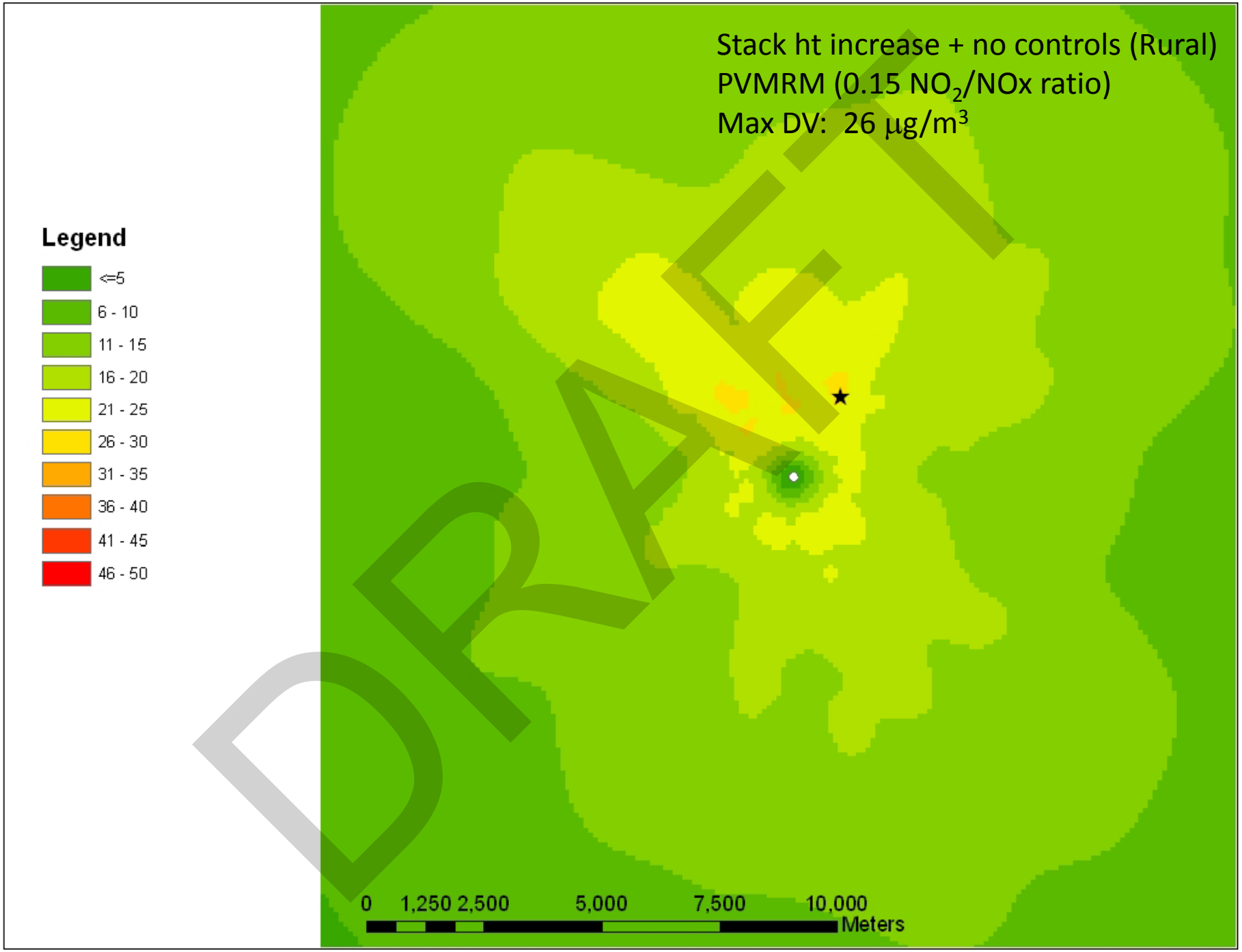

Stack ht increase + no controls (Rural)
100% conversion
Max DV: 40 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

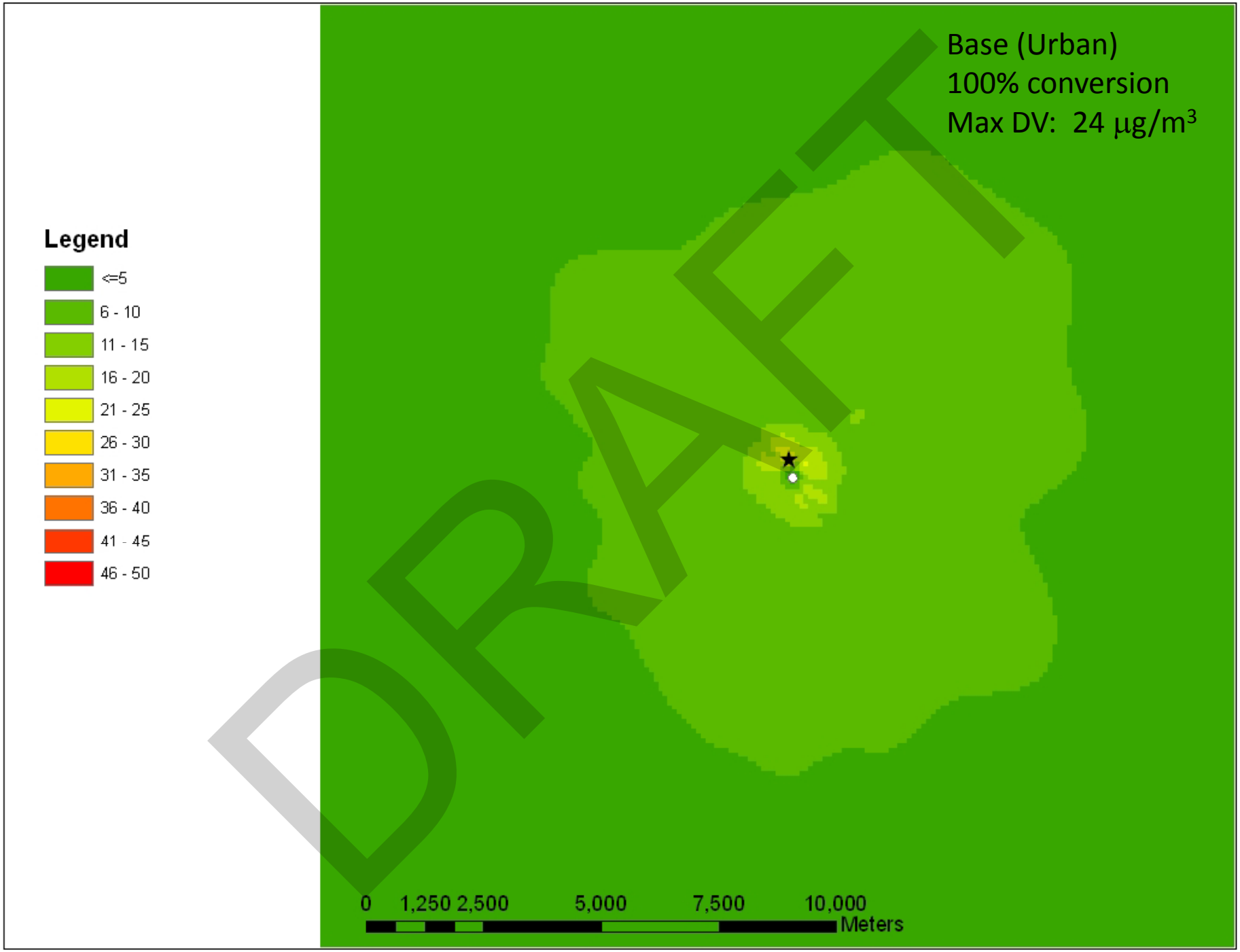

Stack ht increase + no controls (Rural)
80% conversion
Max DV: 32 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

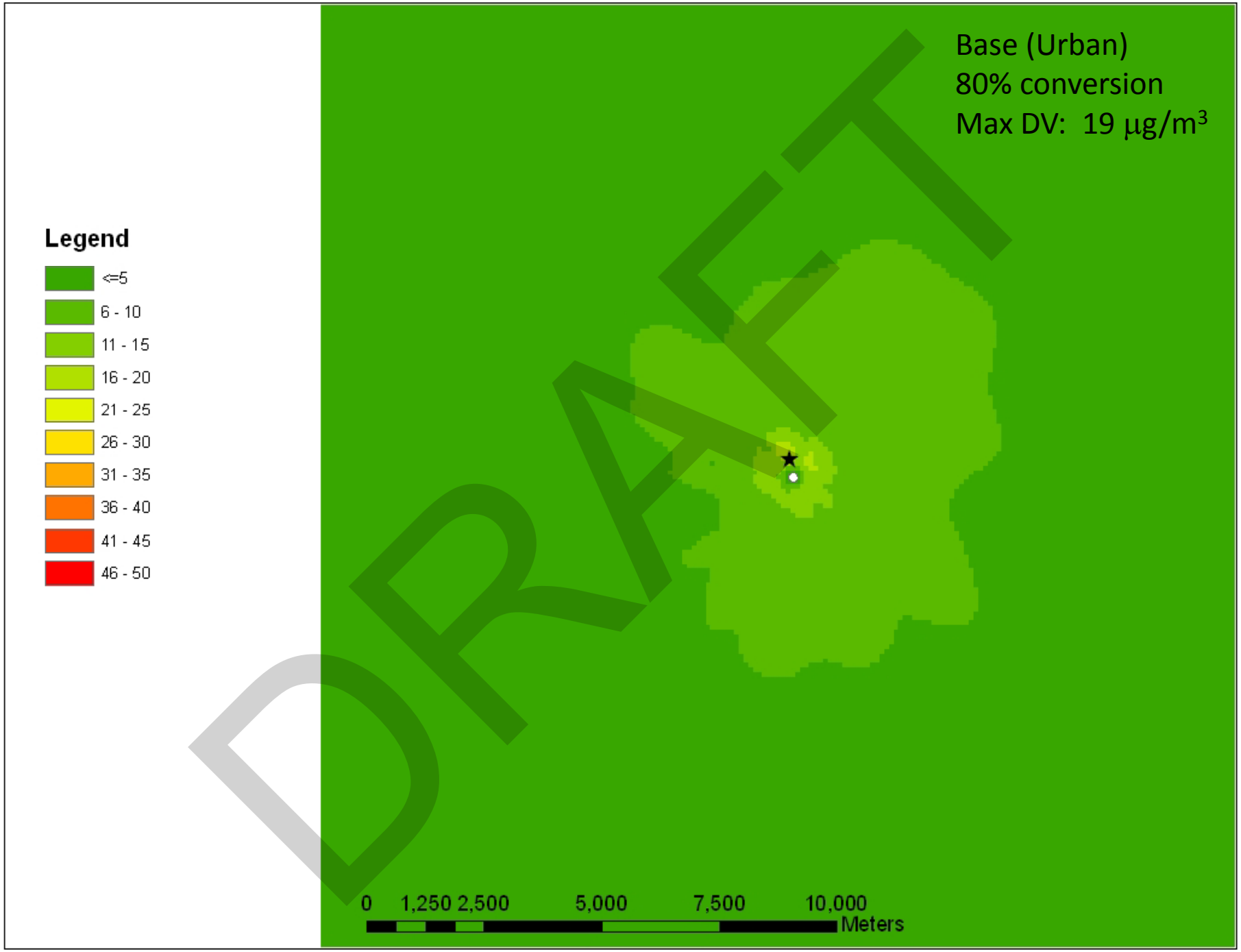

Stack ht increase + no controls (Rural)
OLM (0.1 NO2/NOx ratio)
Max DV: 36 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

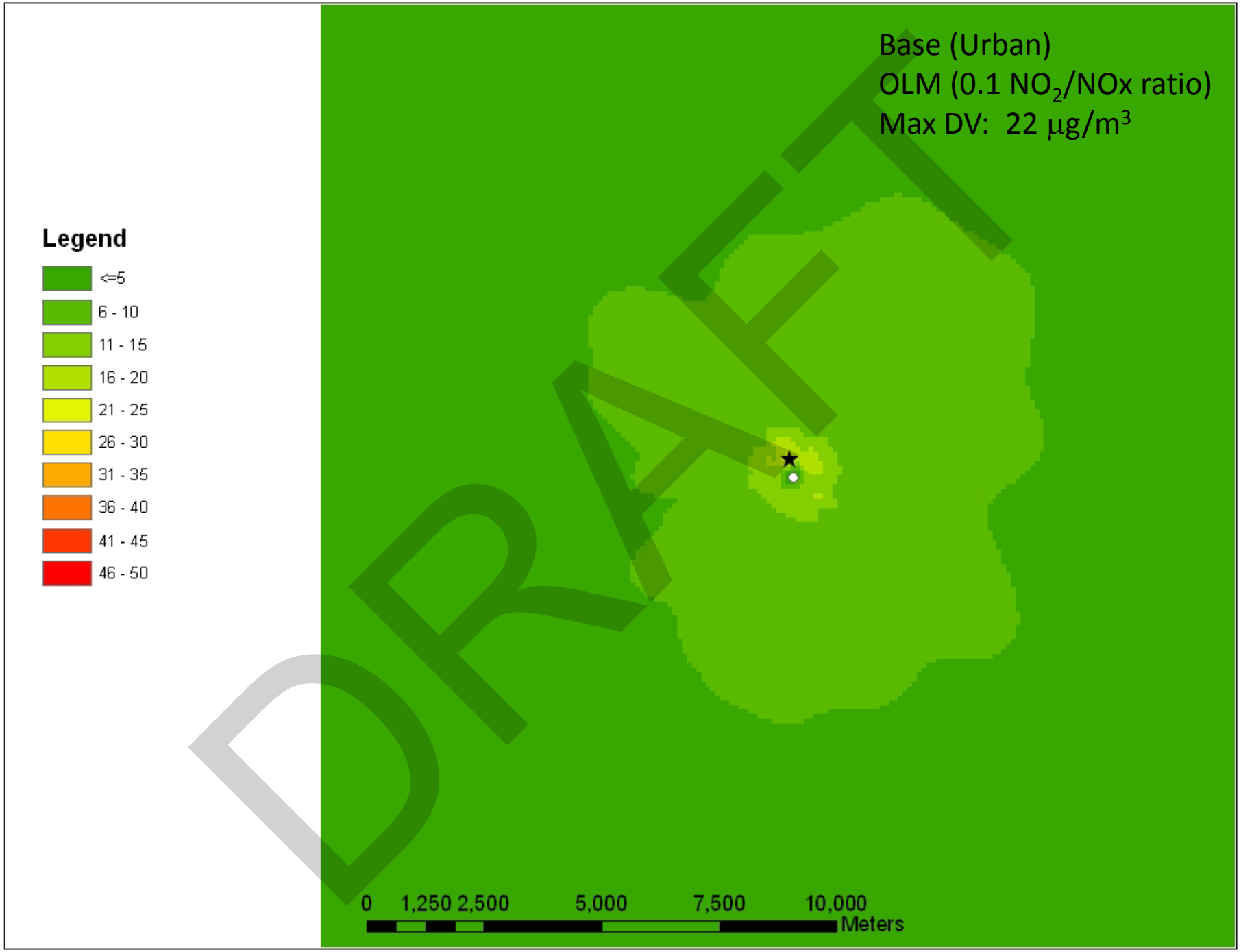

Stack ht increase + no controls (Rural)
OLM (0.15 NO2/NOx ratio)
Max DV: 36 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

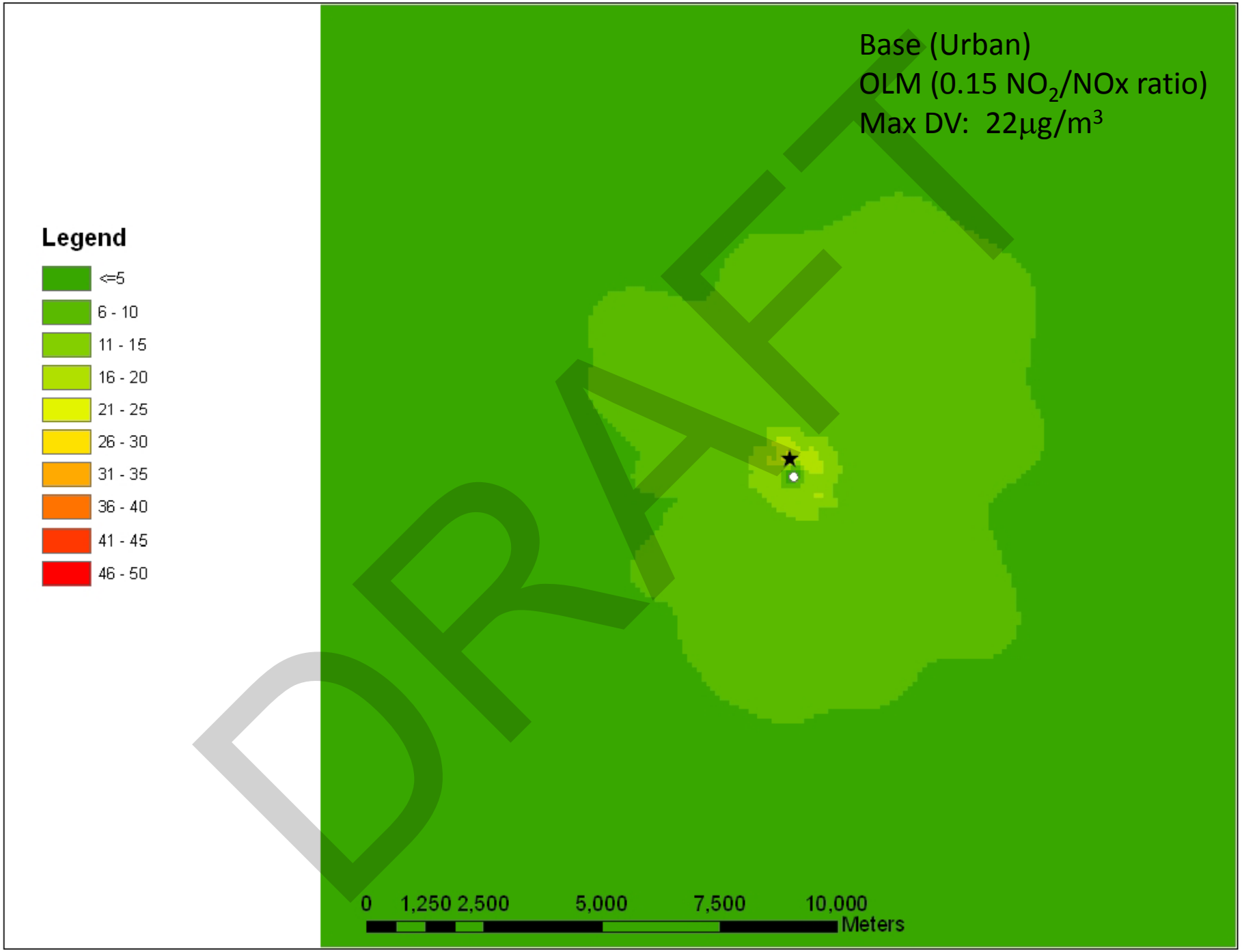

Stack ht increase + no controls (Rural)
PVMRM (0.1 NO2/NOx ratio)
Max DV: 26 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

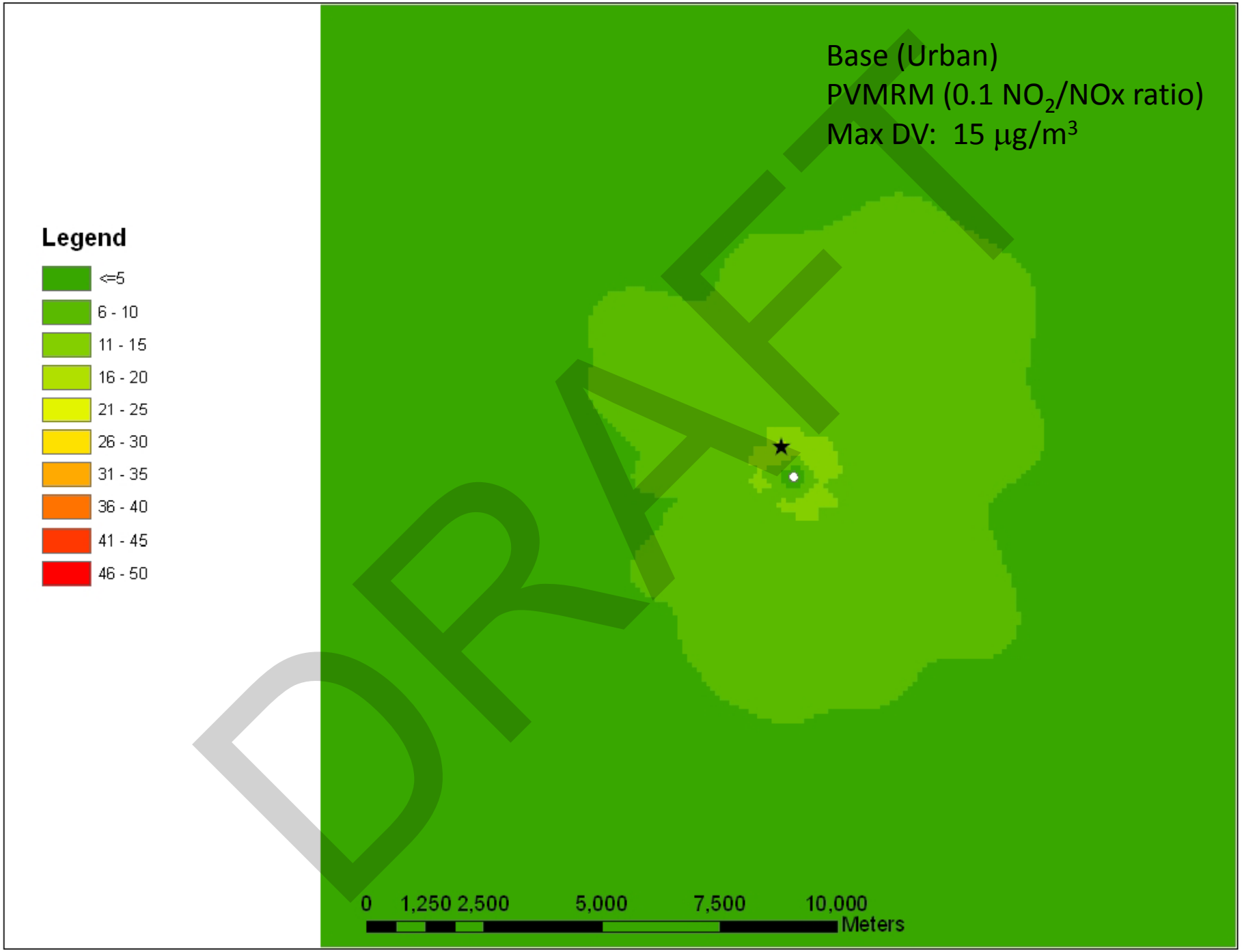

Stack ht increase + no controls (Rural)
PVMRM (0.15 NO2/NOx ratio)
Max DV: 26 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

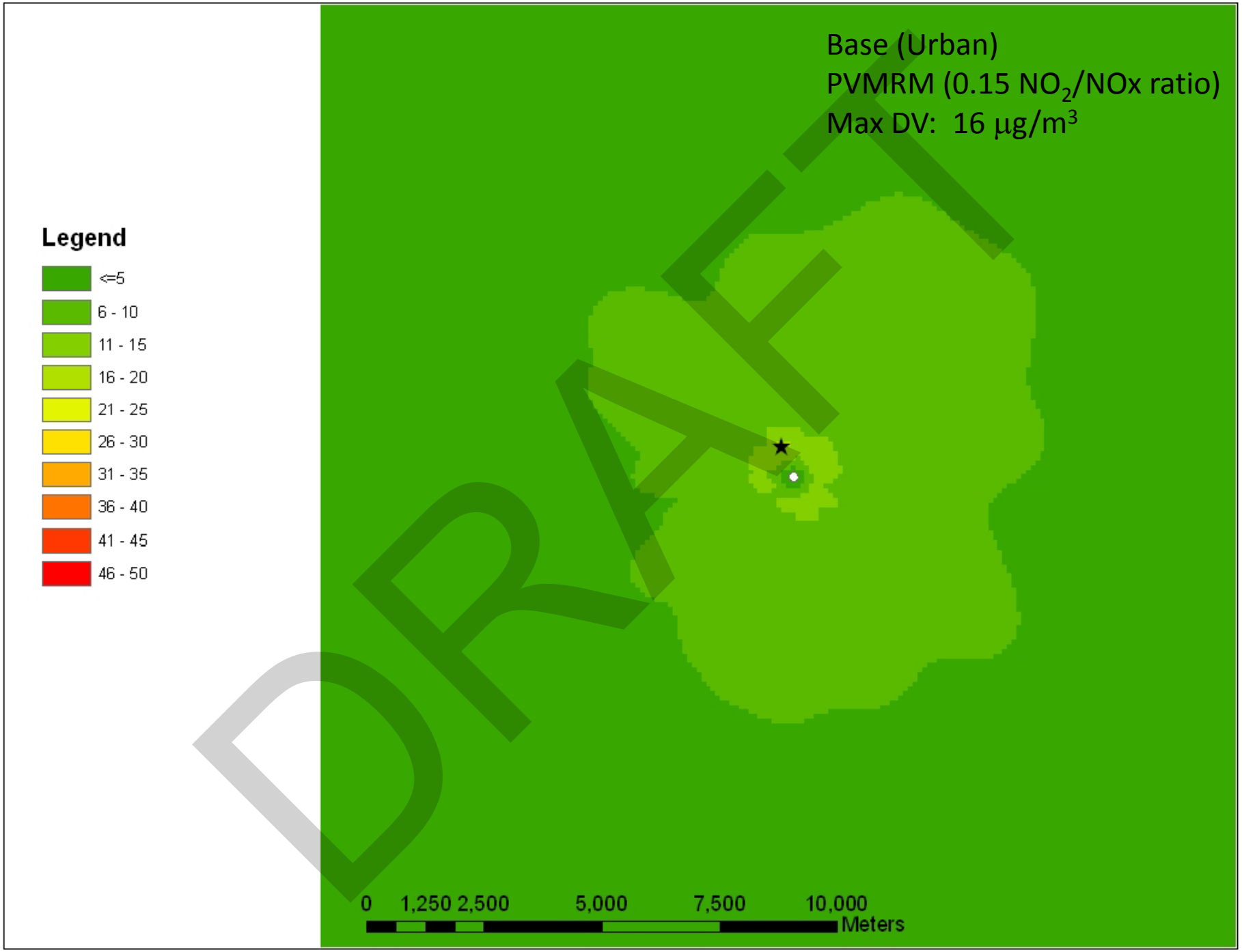

Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
Base (Urban)
100% conversion
Max DV: 24 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

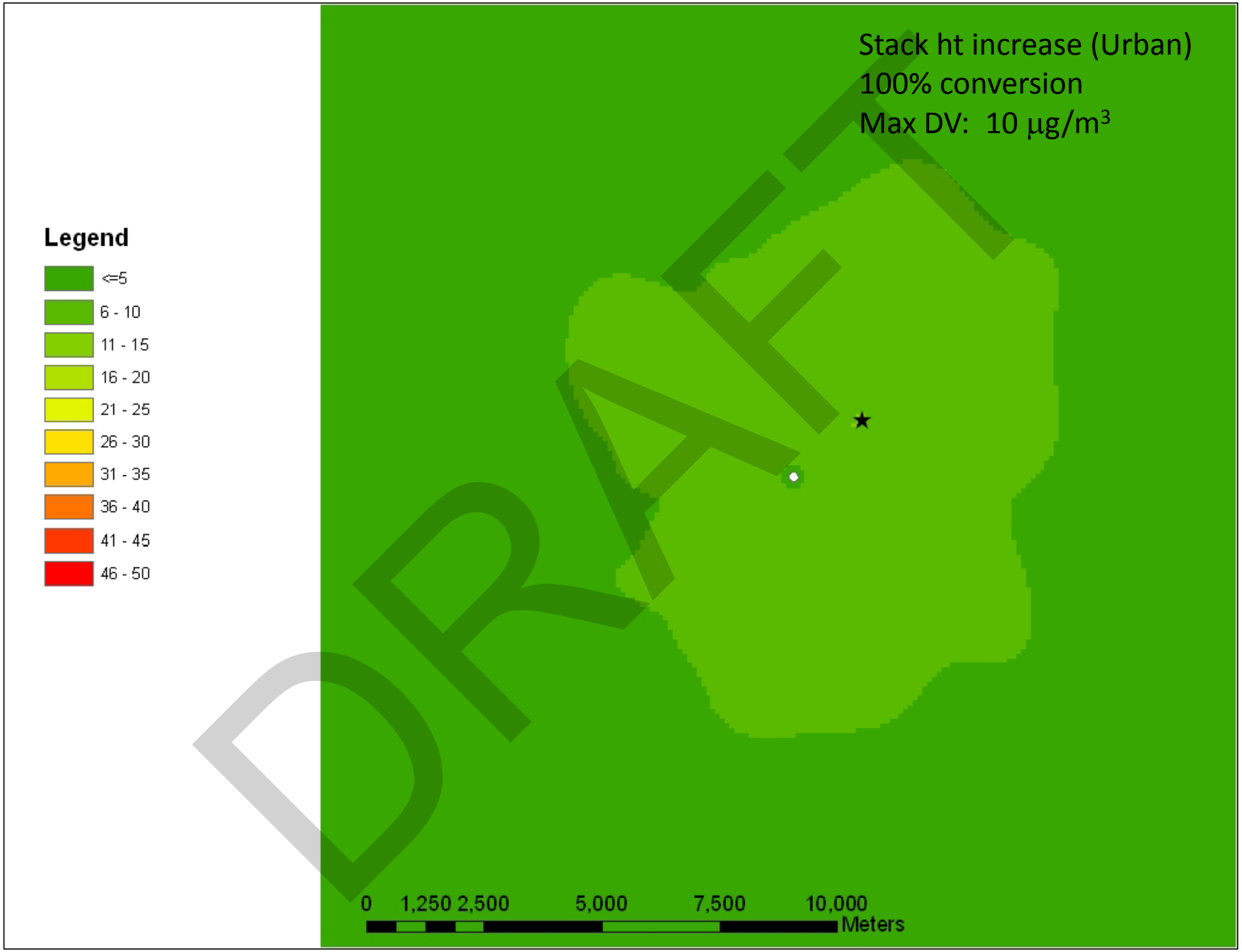

Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
Base (Urban)
80% conversion
Max DV: 19 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

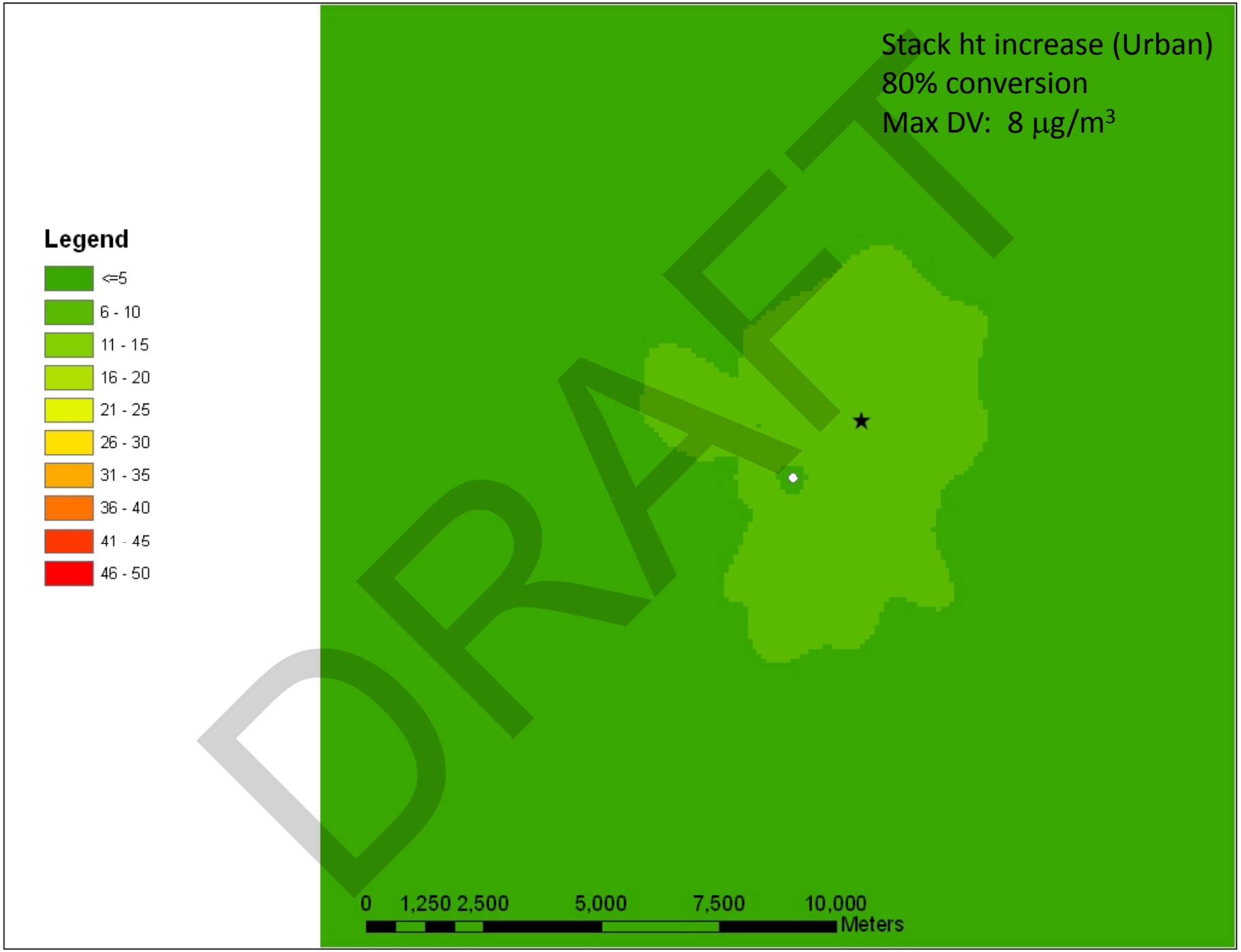

Base (Urban)
OLM (0.1 NO_2/NOx ratio)
Max DV: 22 µg/m^3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

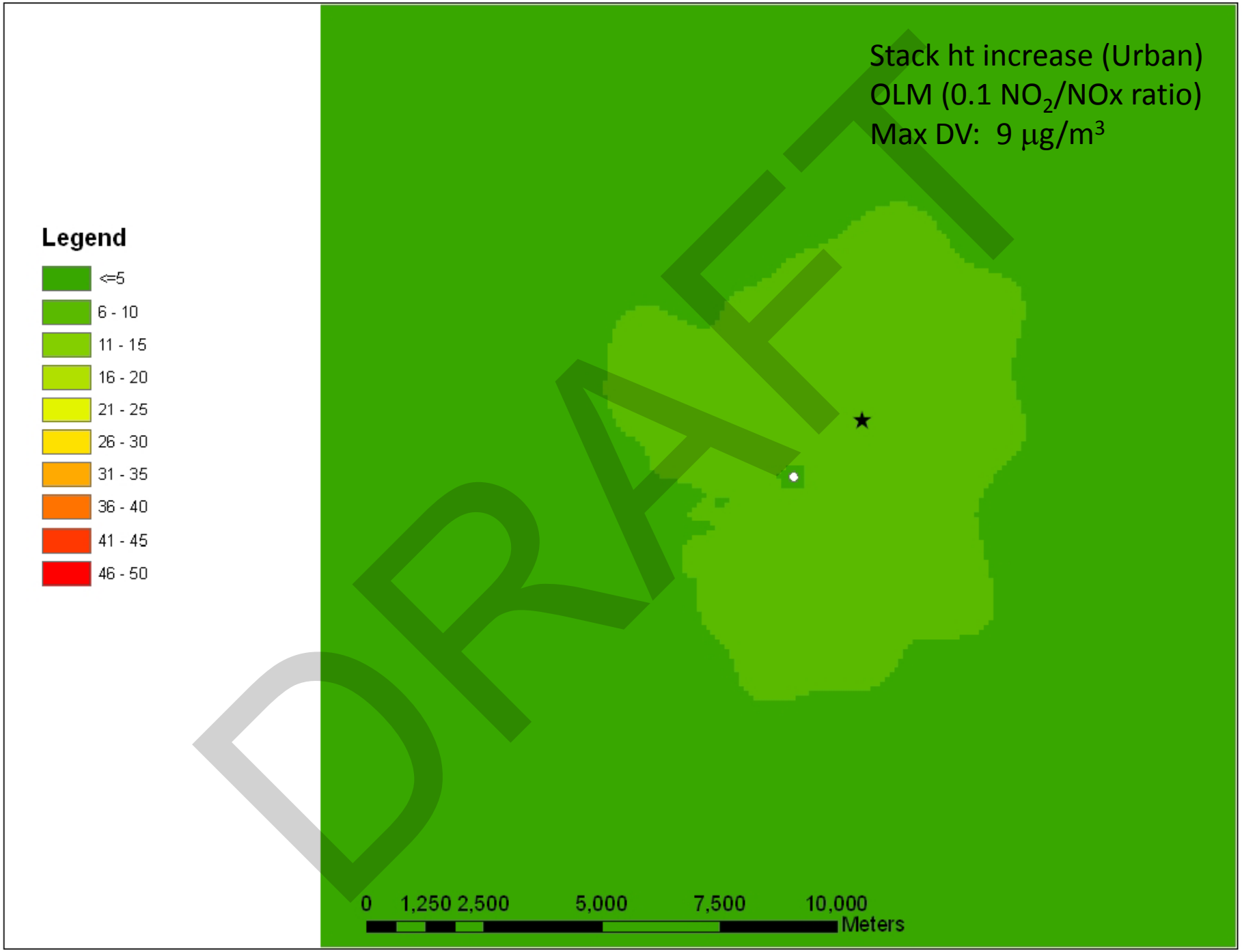

Base (Urban)
OLM (0.15 NO2/NOx ratio)
Max DV: 22µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

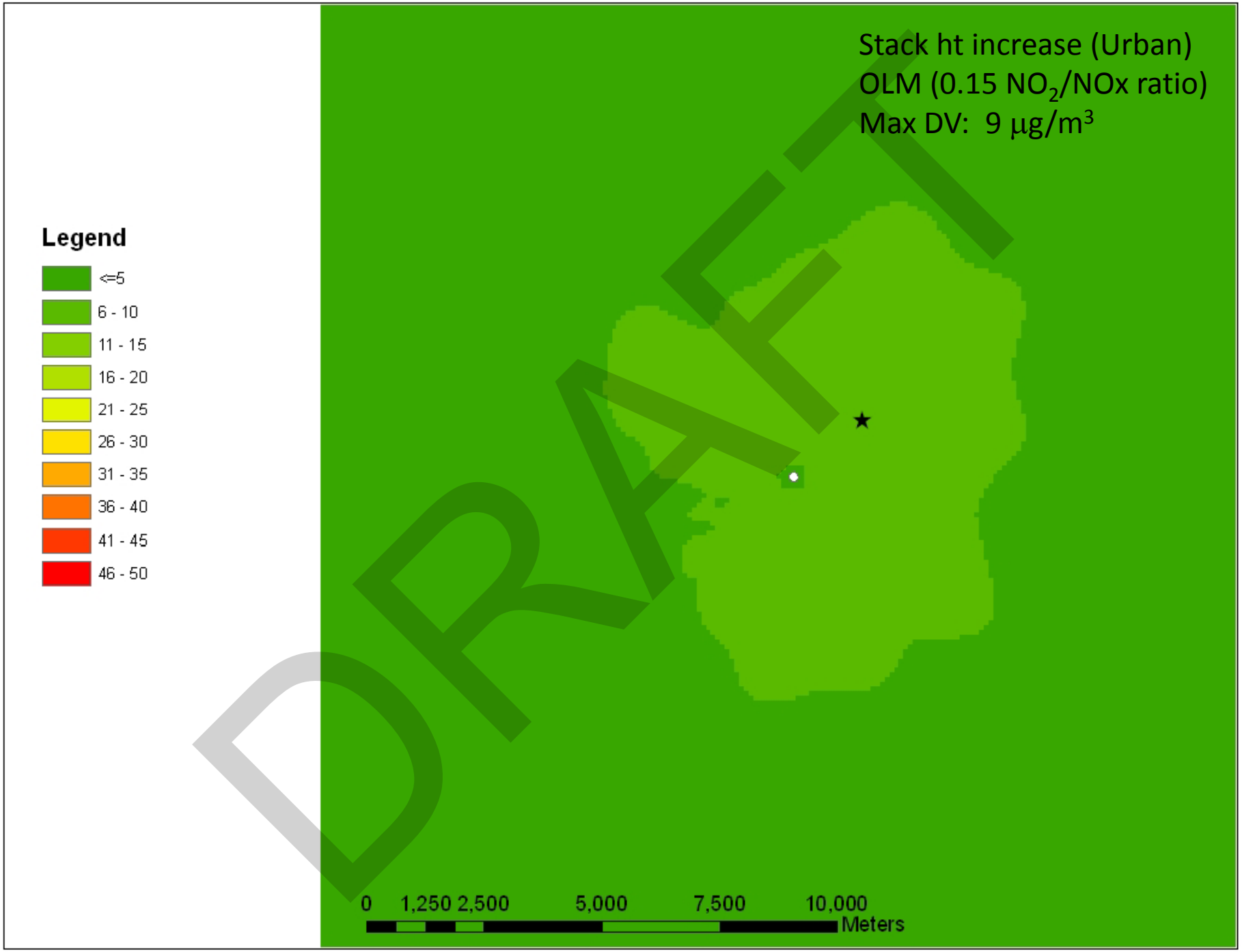

Base (Urban)
PVMRM (0.1 NO_2/NOx ratio)
Max DV: 15 µg/m^3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

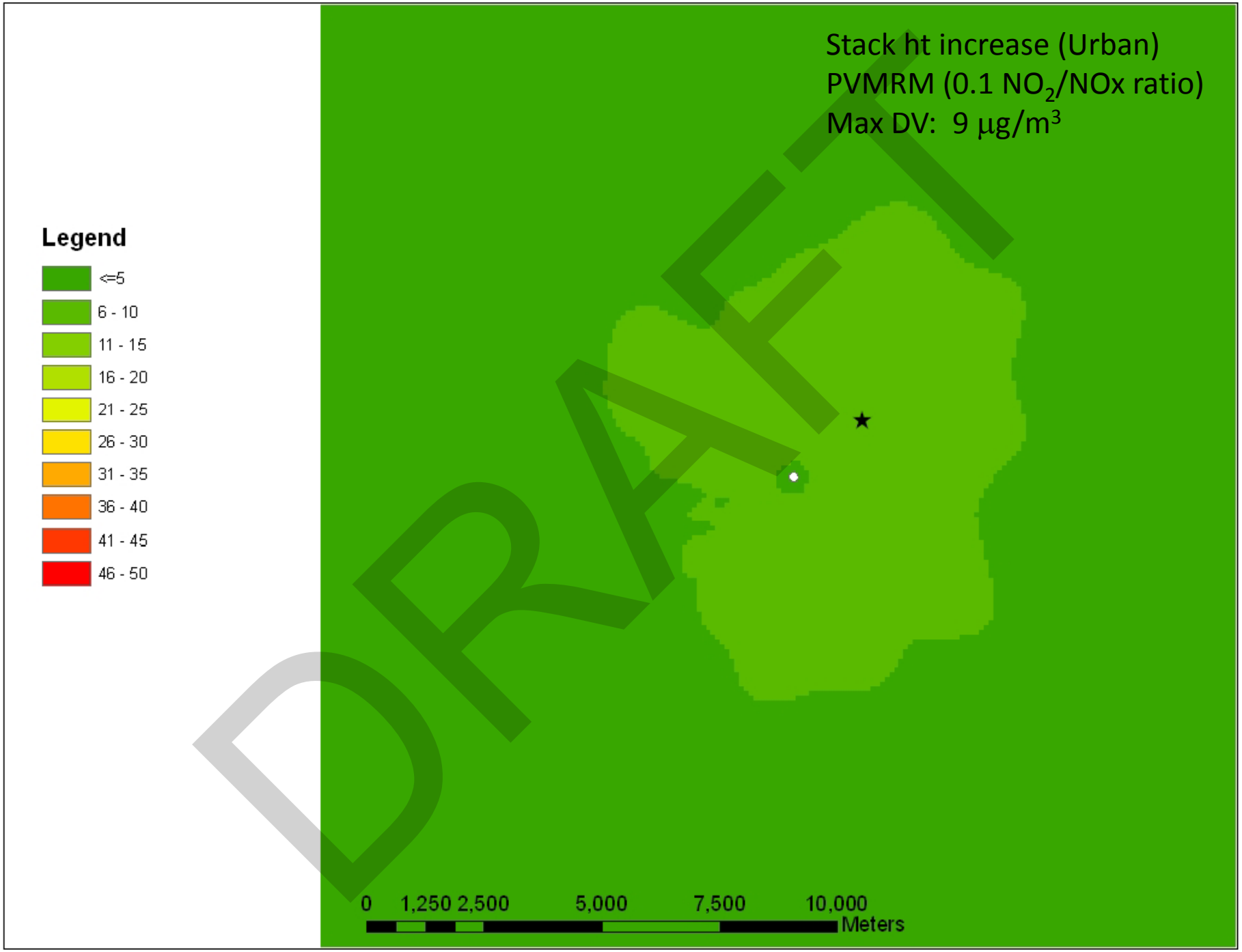

Base (Urban)
PVMRM (0.15 NO2/NOx ratio)
Max DV: 16 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

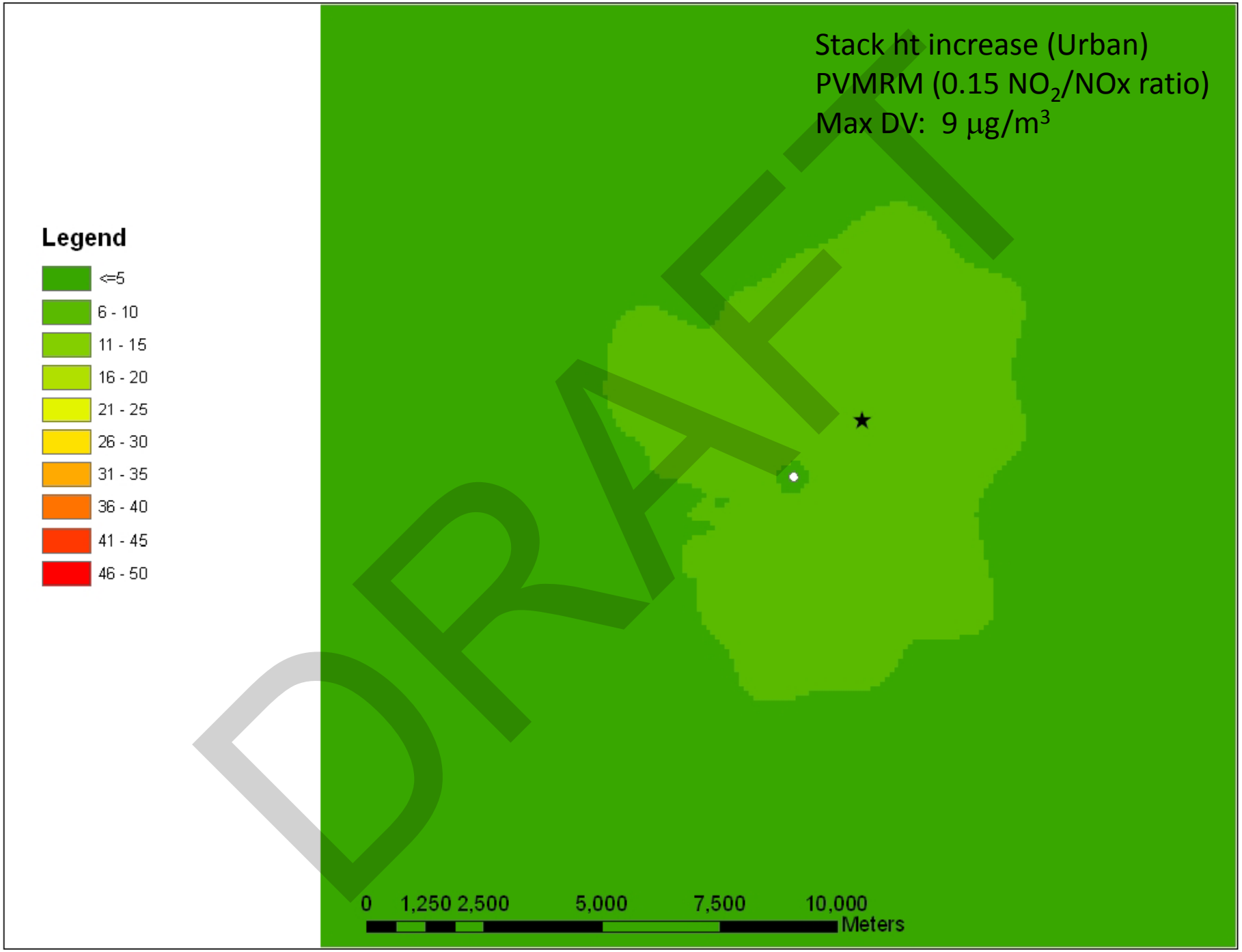

Stack ht increase (Urban)
100% conversion
Max DV: 10 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

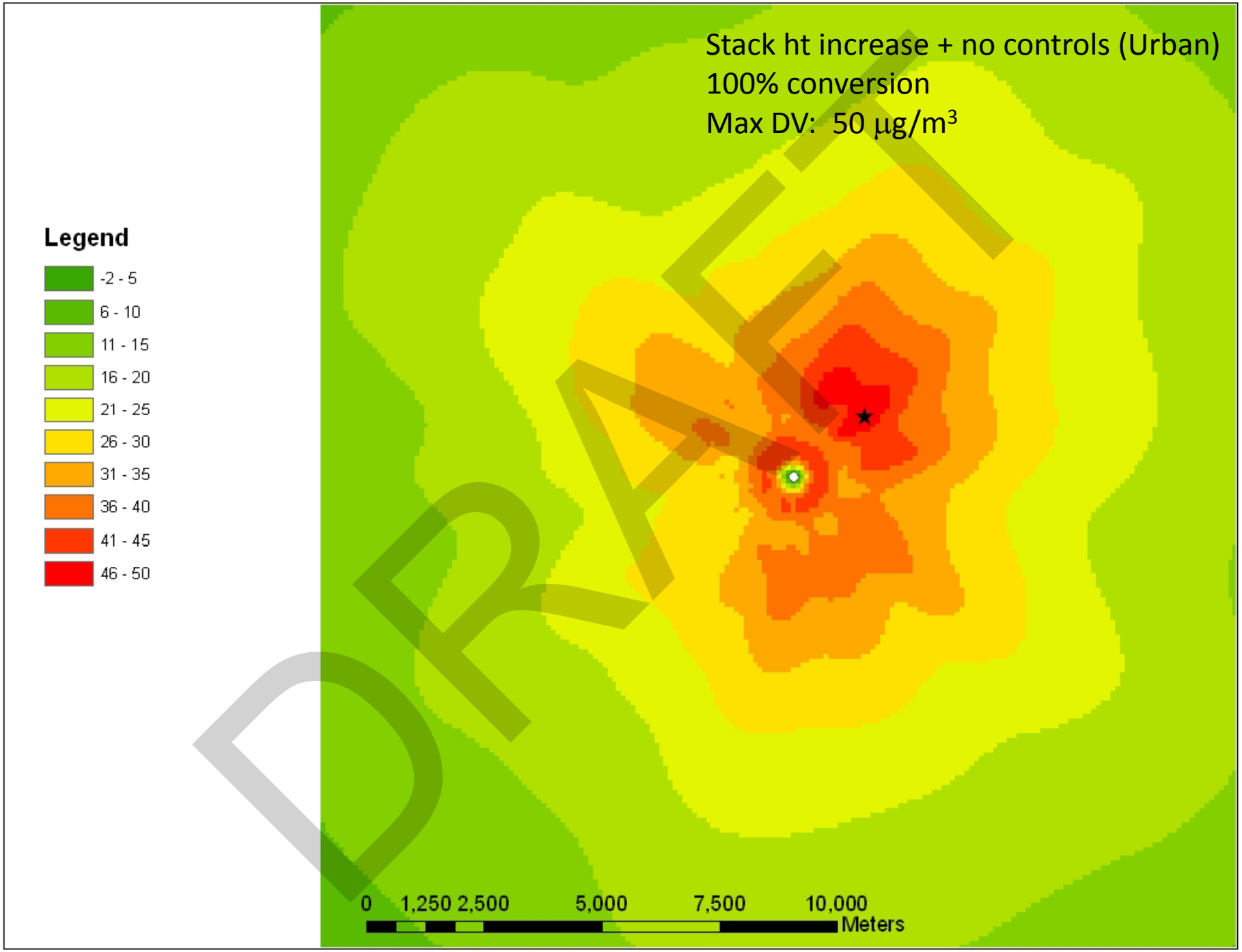

Stack ht increase (Urban)
80% conversion
Max DV: 8 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

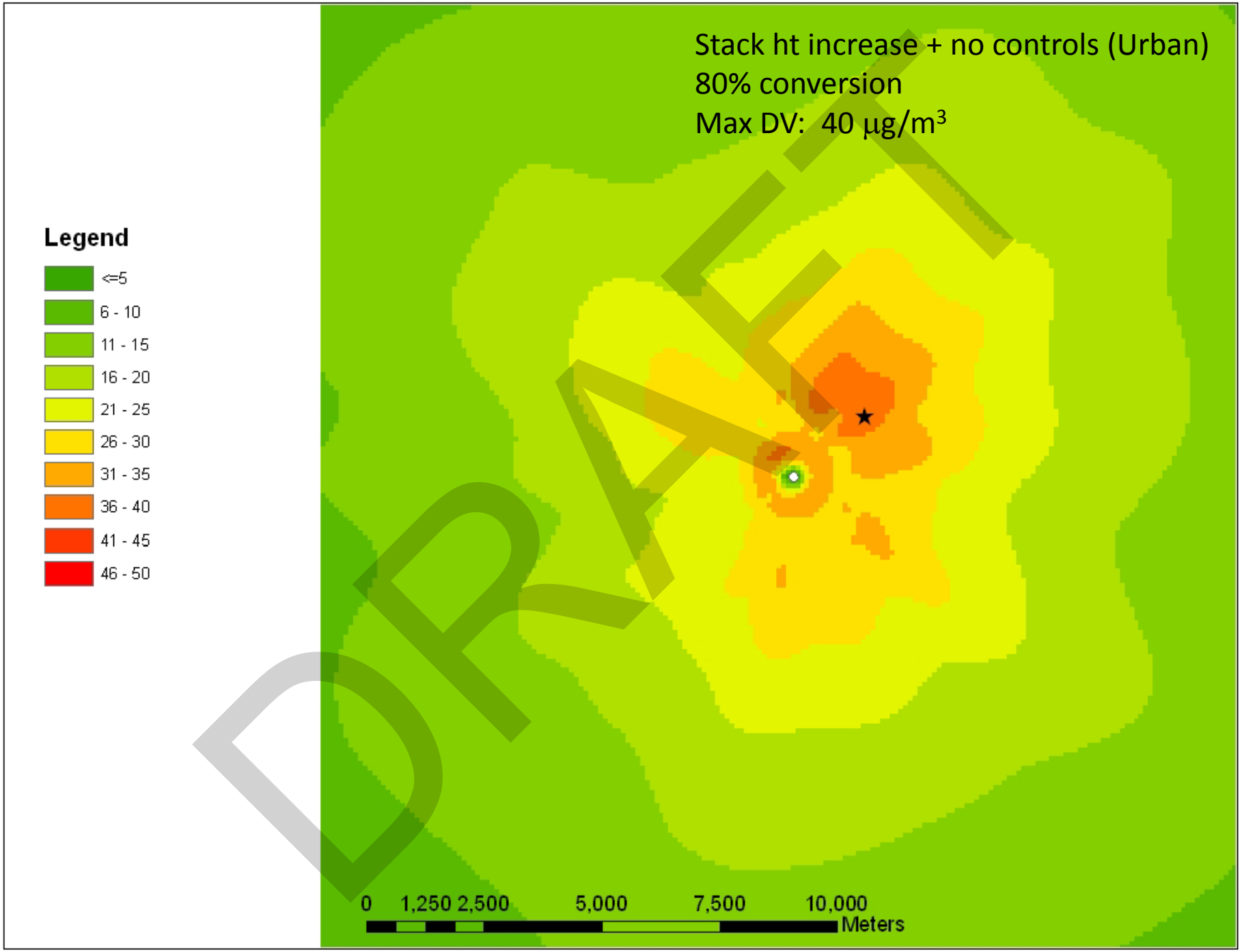

Stack ht increase (Urban)
OLM (0.1 NO2/NOx ratio)
Max DV: 9 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

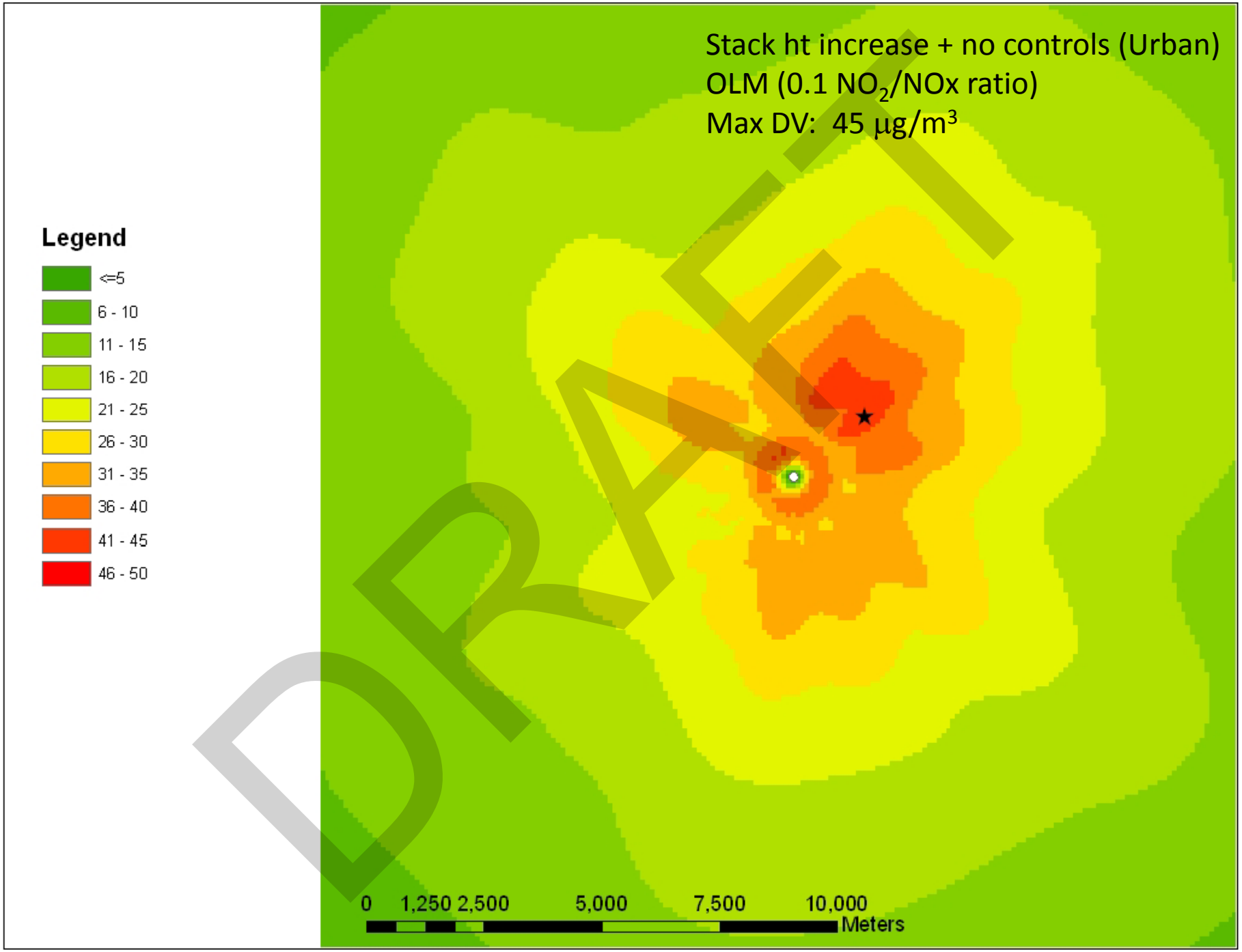

Stack ht increase (Urban)
OLM (0.15 NO2/NOx ratio)
Max DV: 9 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

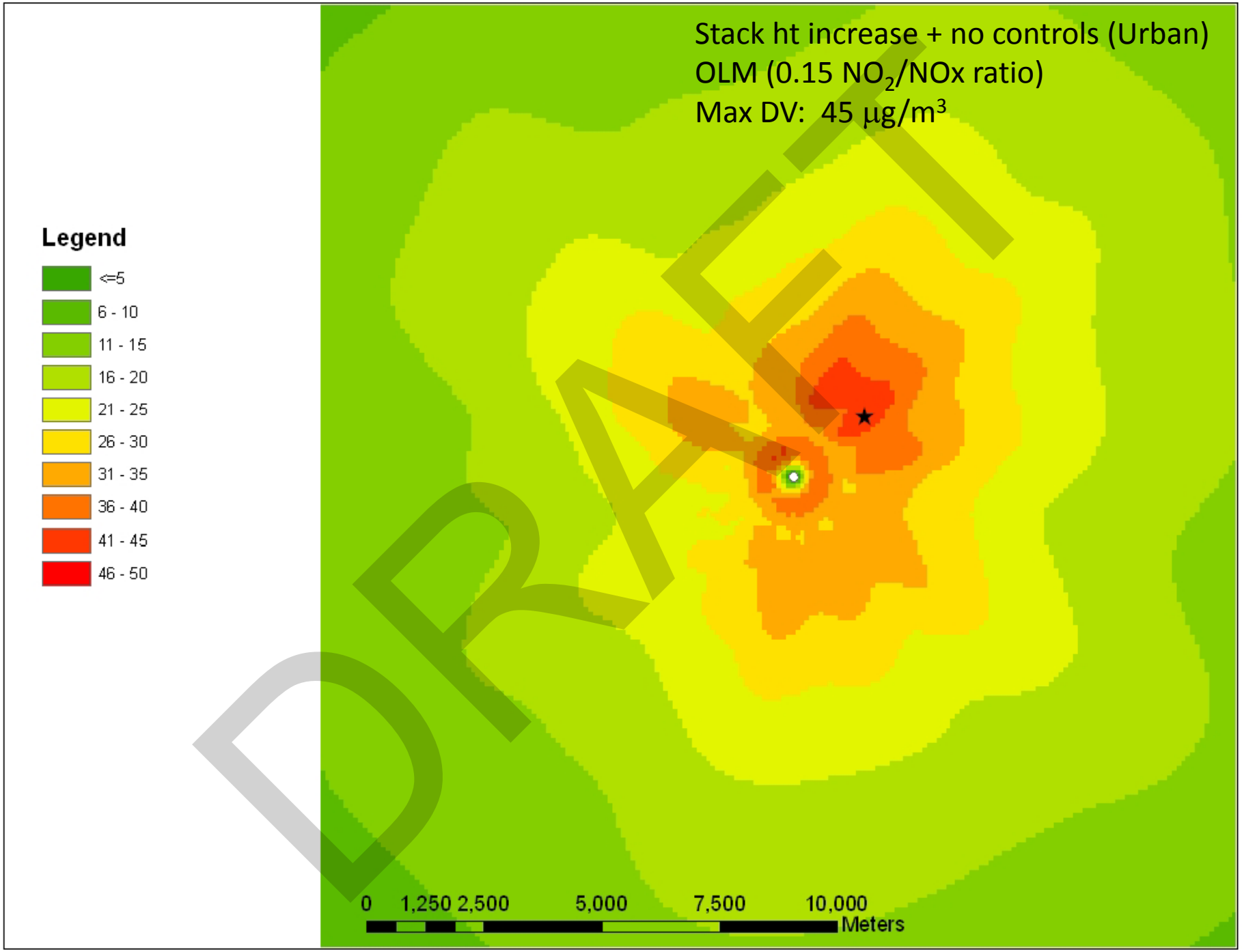

Stack ht increase (Urban)
PVMRM (0.1 NO2/NOx ratio)
Max DV: 9 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase (Urban)
PVMRM (0.15 NO2/NOx ratio)
Max DV: 9 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

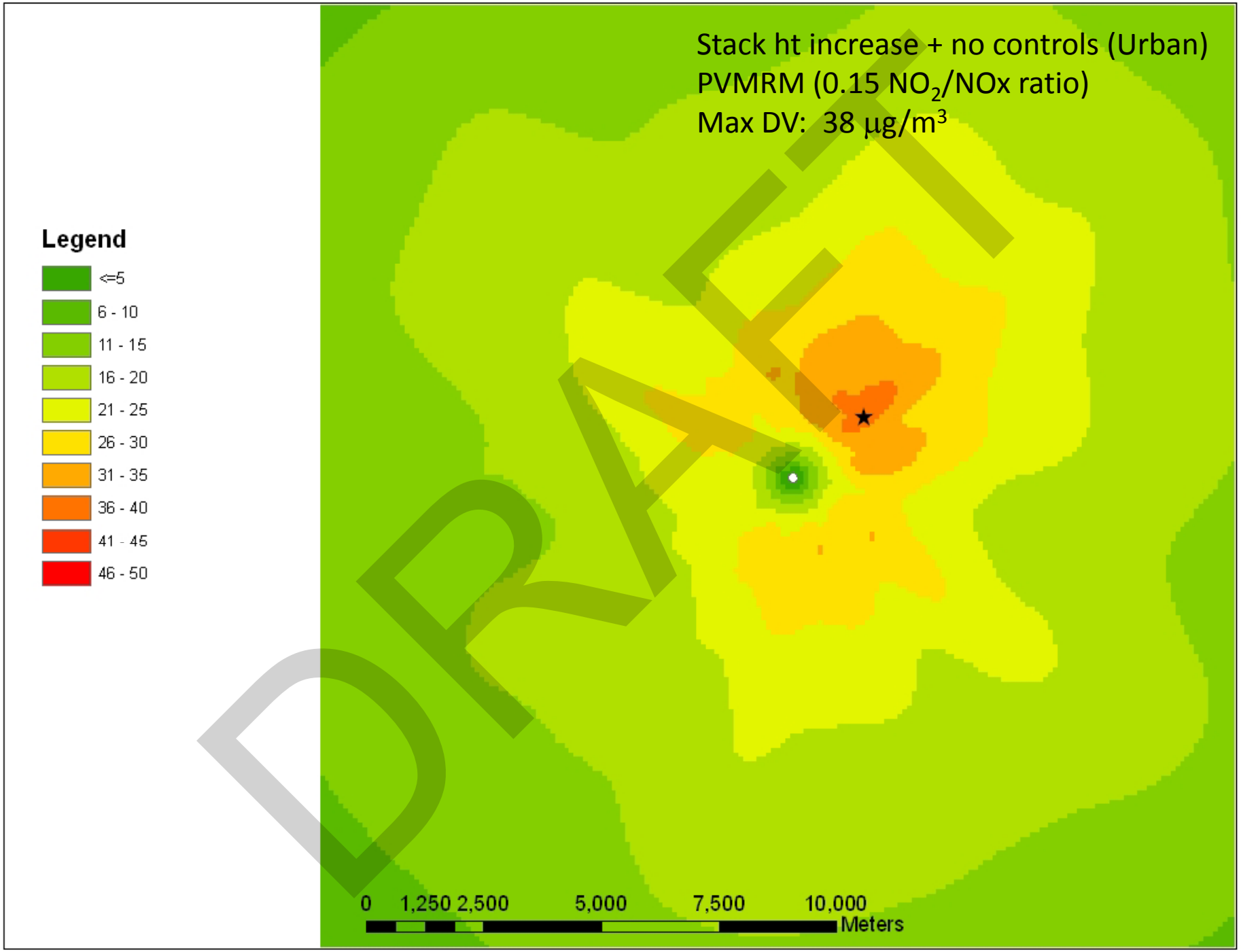

Stack ht increase + no controls (Urban)
100% conversion
Max DV: 50 µg/m3
Legend
-2 - 5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

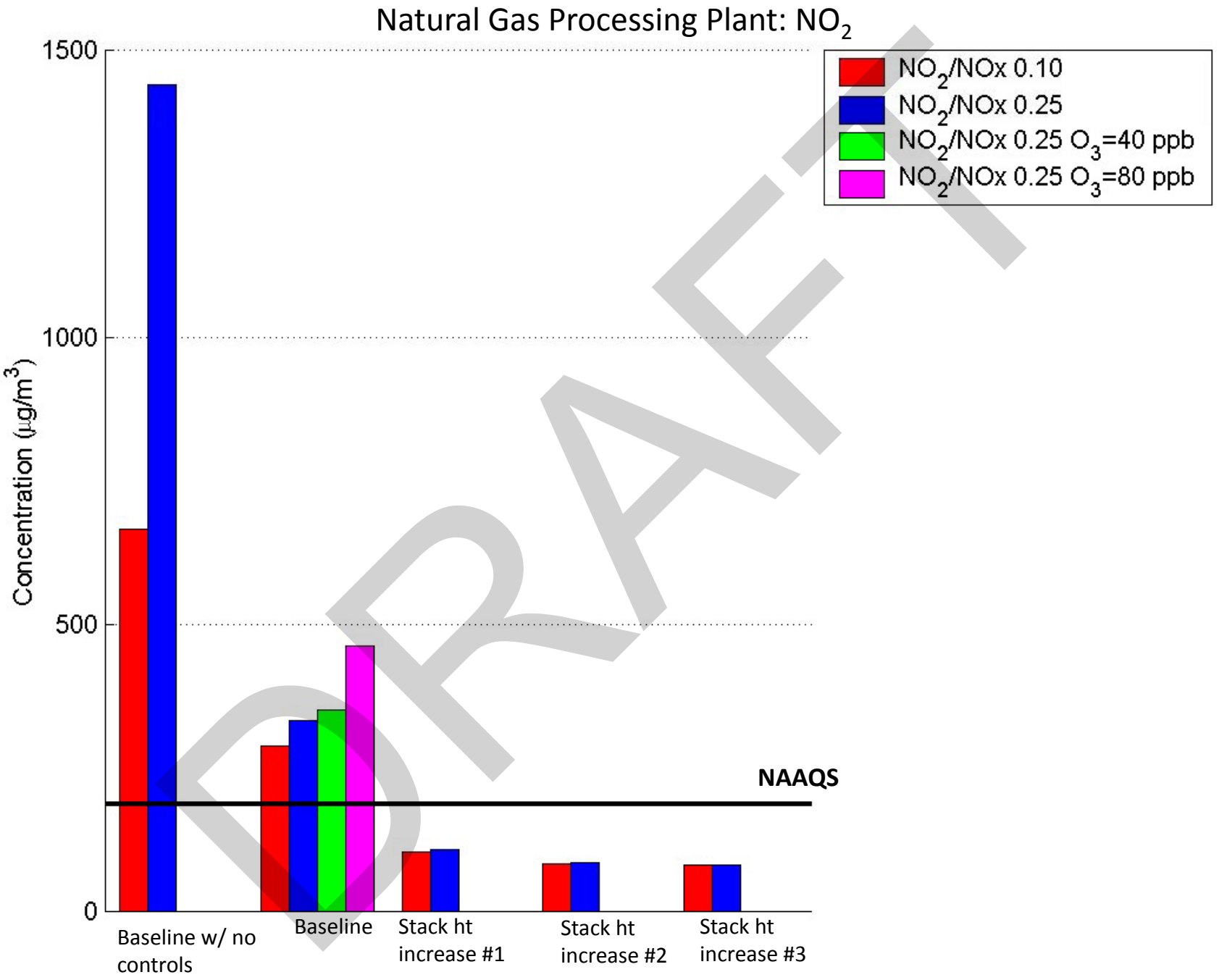

Stack ht increase + no controls (Urban)
80% conversion
Max DV: 40 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters

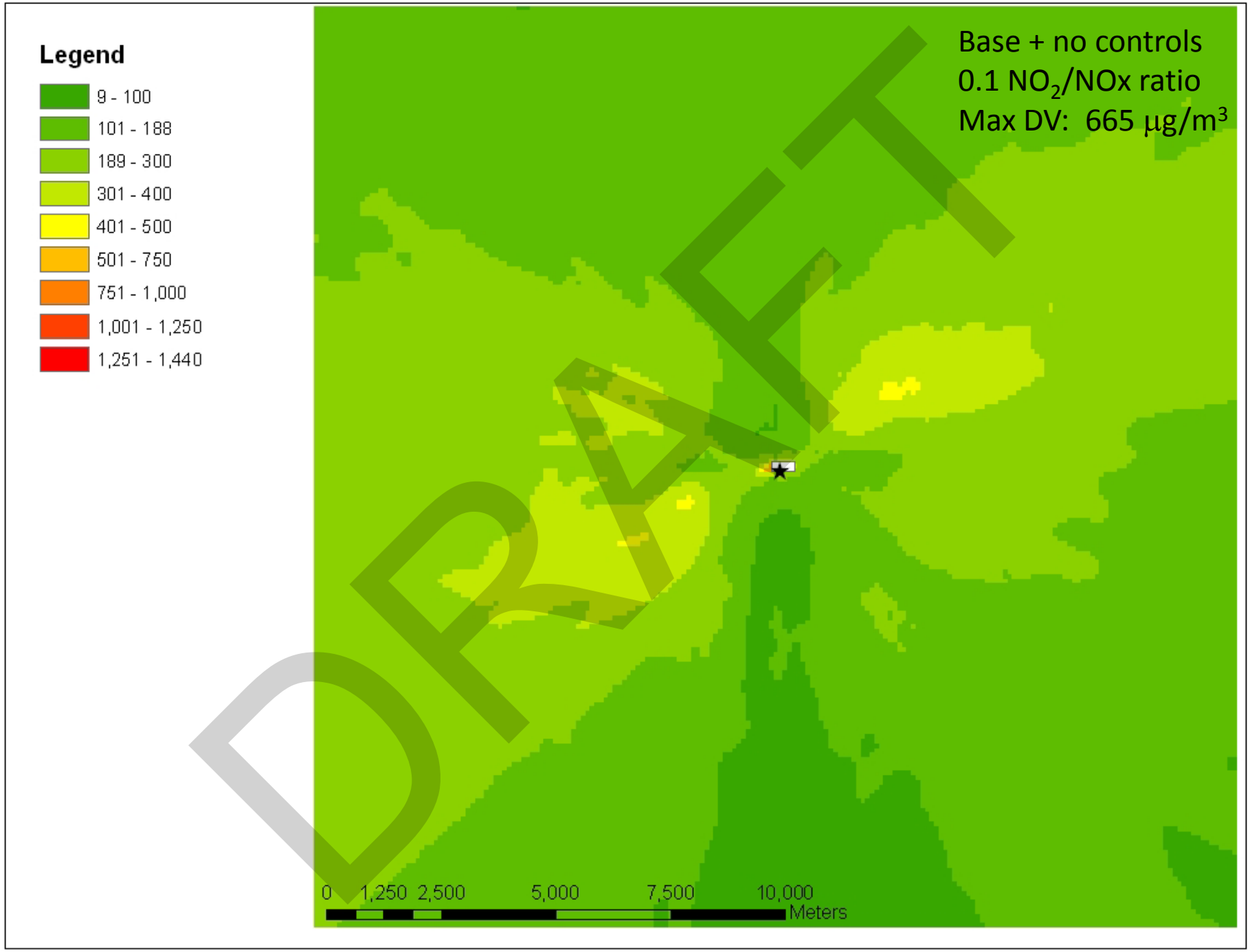

Stack ht increase + no controls (Urban)
OLM (0.1 NO2/NOx ratio)
Max DV: 45 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

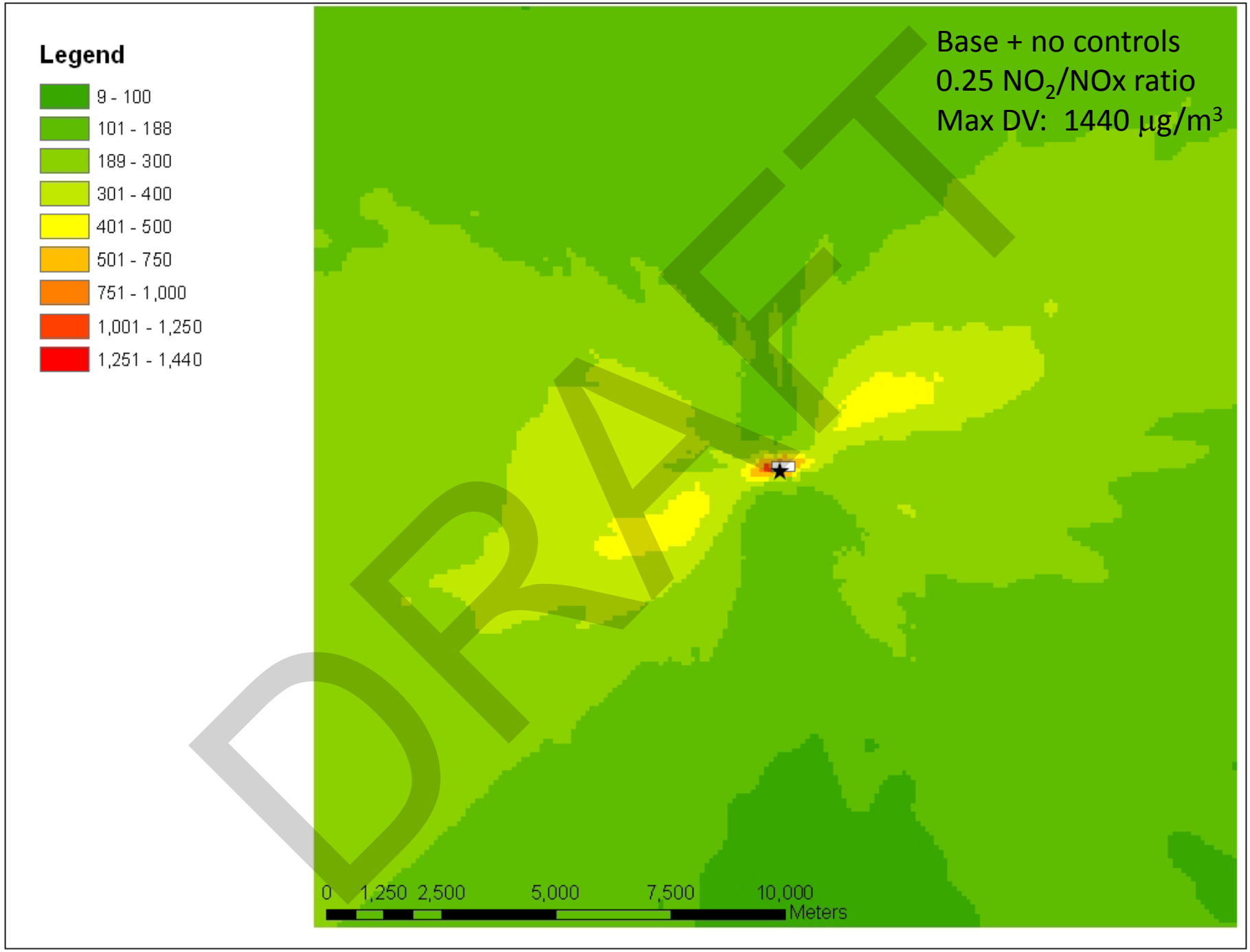

Stack ht increase + no controls (Urban)
OLM (0.15 NO2/NOx ratio)
Max DV: 45 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Stack ht increase + no controls (Urban)
PVMRM (0.1 NO2/NOx ratio)
Max DV: 36 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

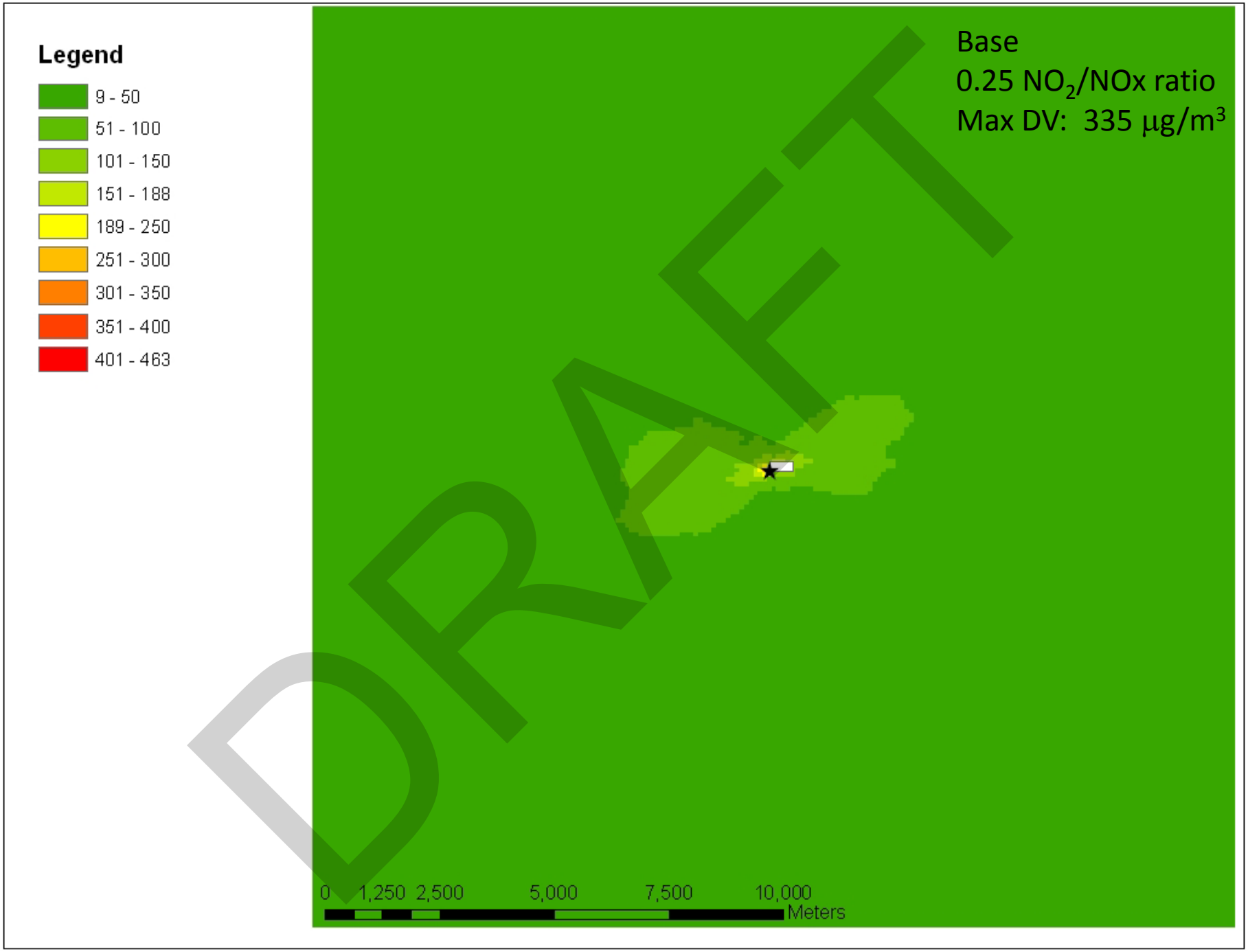

Stack ht increase + no controls (Urban)
PVMRM (0.15 NO2/NOx ratio)
Max DV: 38 µg/m3
Legend
<=5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

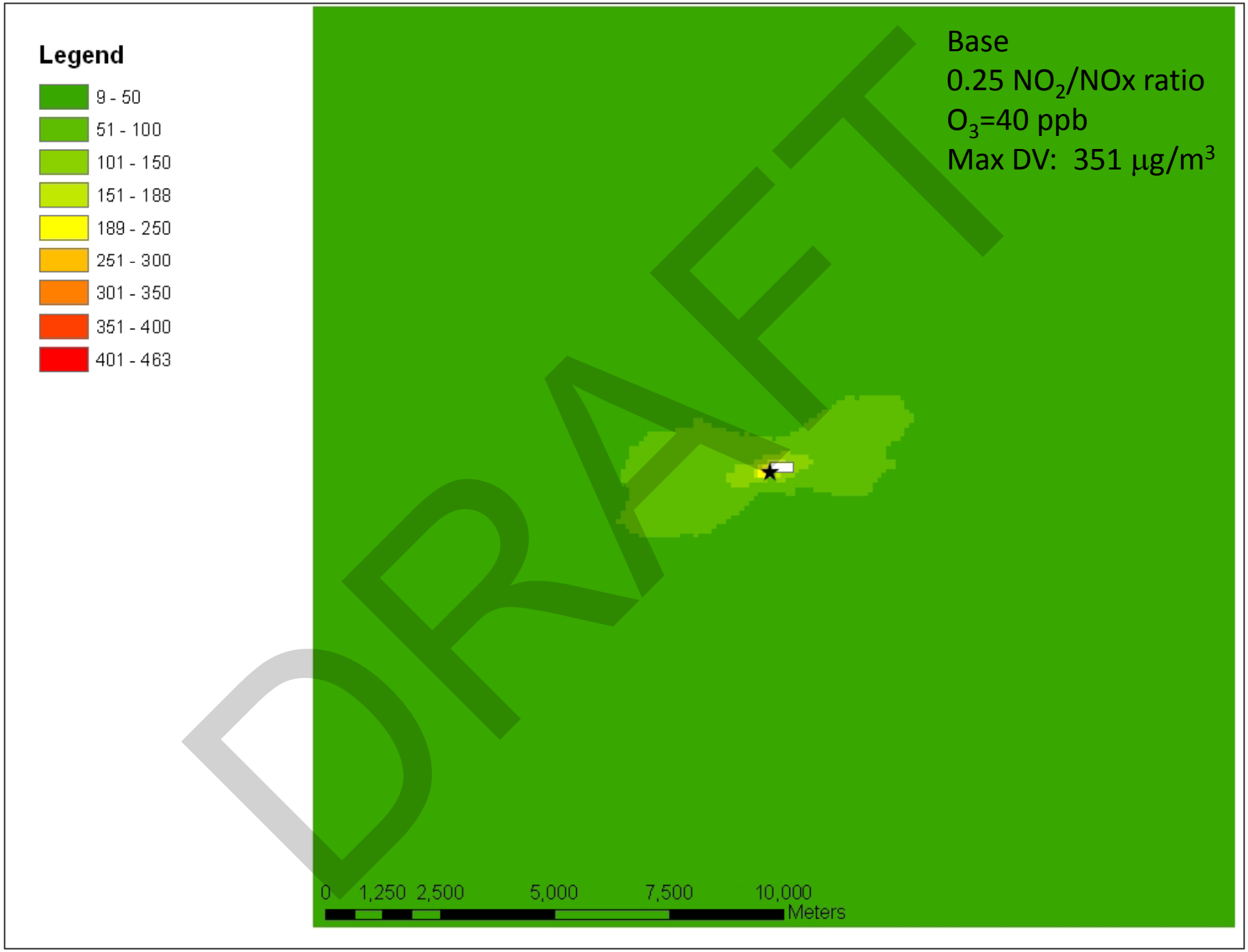

Natural Gas Processing Plant: NO2
1500
1000
500
0
Concentration (μg/m3)
NO2/NOx 0.10
NO2/NOx 0.25
NO2/NOx 0.25 O3=40 ppb
NO2/NOx 0.25 O3=80 ppb
NAAQS
Baseline w/ no controls
Baseline
Stack ht increase #1
Stack ht increase #2
Stack ht increase #3

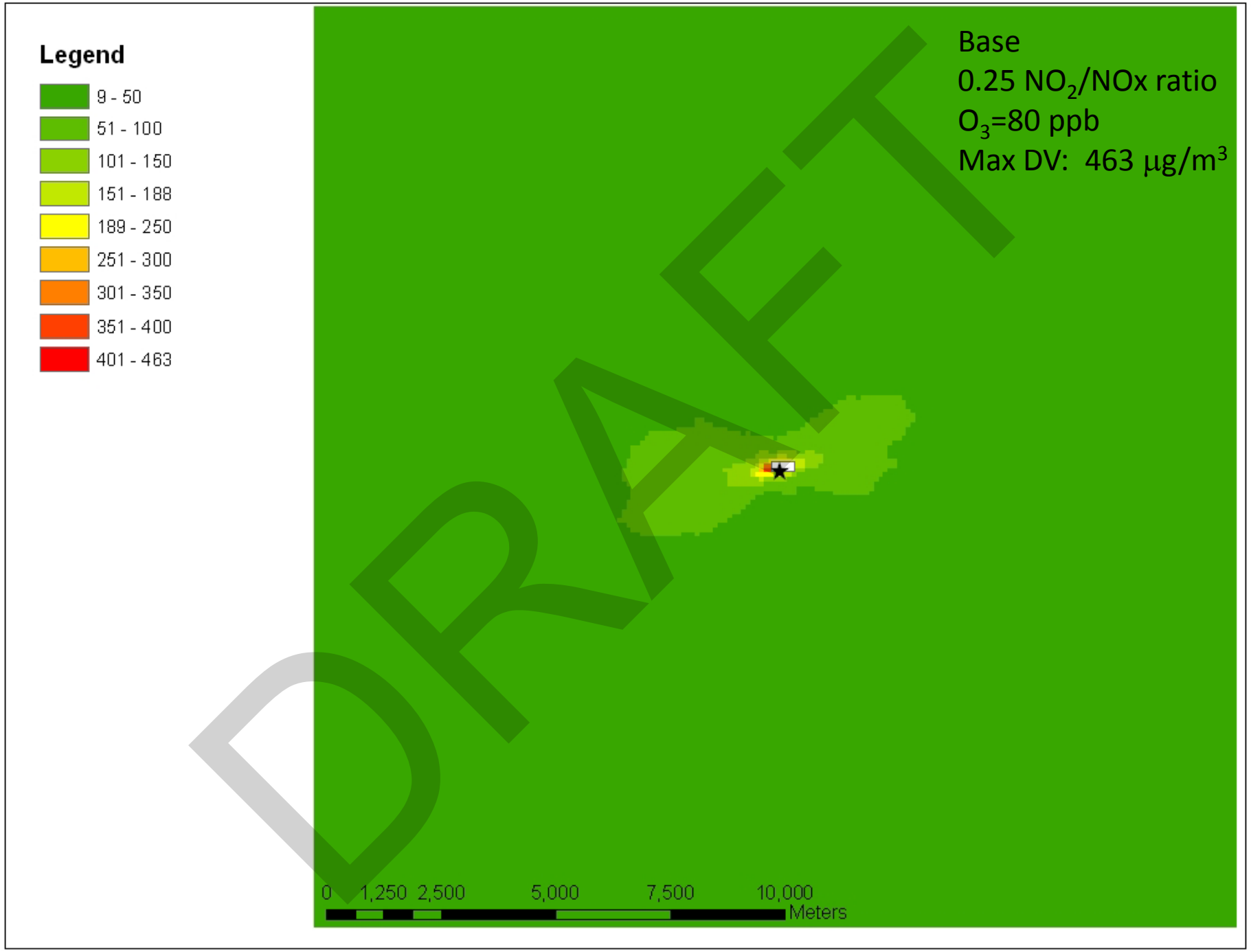

Legend
9 - 100
101 - 188
189 - 300
301 - 400
401 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,440
Base + no controls
0.1 NO2/NOx ratio
Max DV: 665 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT


Legend
9 - 100
101 - 188
189 - 300
301 - 400
401 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,440
Base + no controls
0.25 NO2/NOx ratio
Max DV: 1440 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Base
0.1 NO2/NOx ratio
Max DV: 289 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Base
0.25 NO2/NOx ratio
Max DV: 335 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

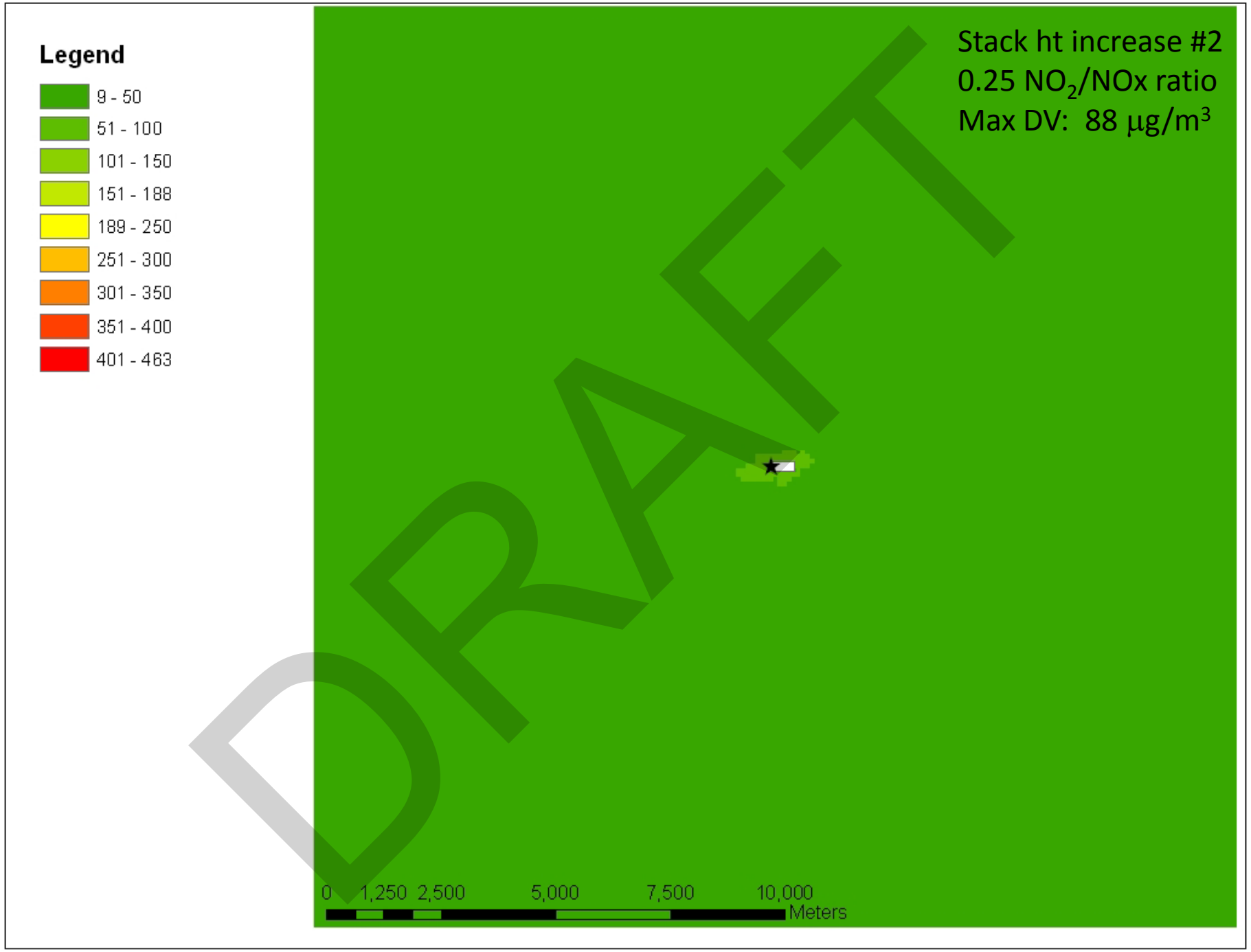

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Base
0.25 NO2/NOx ratio
O3=40 ppb
Max DV: 351 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

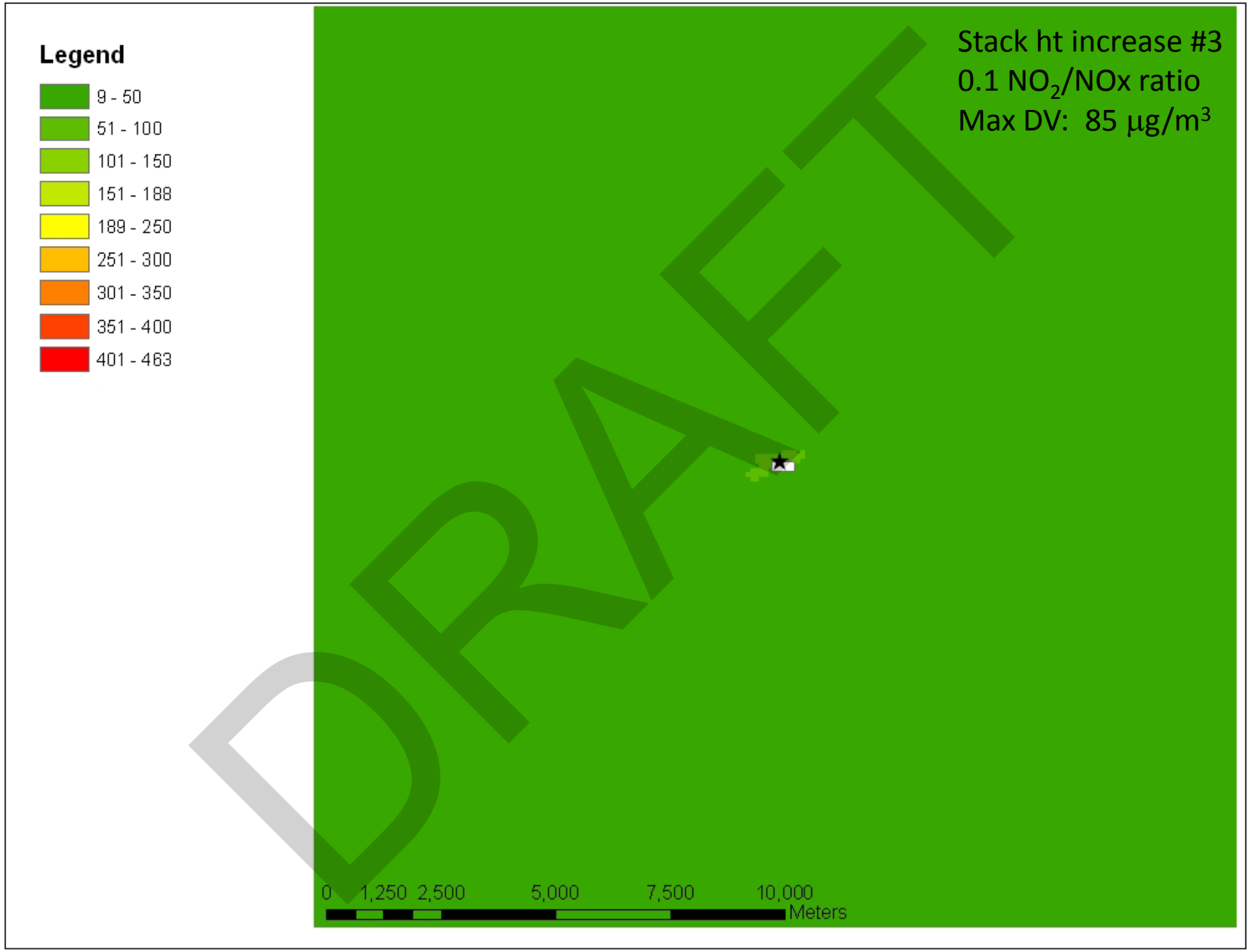

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Base
0.25 NO2/NOx ratio
O3=80 ppb
Max DV: 463 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

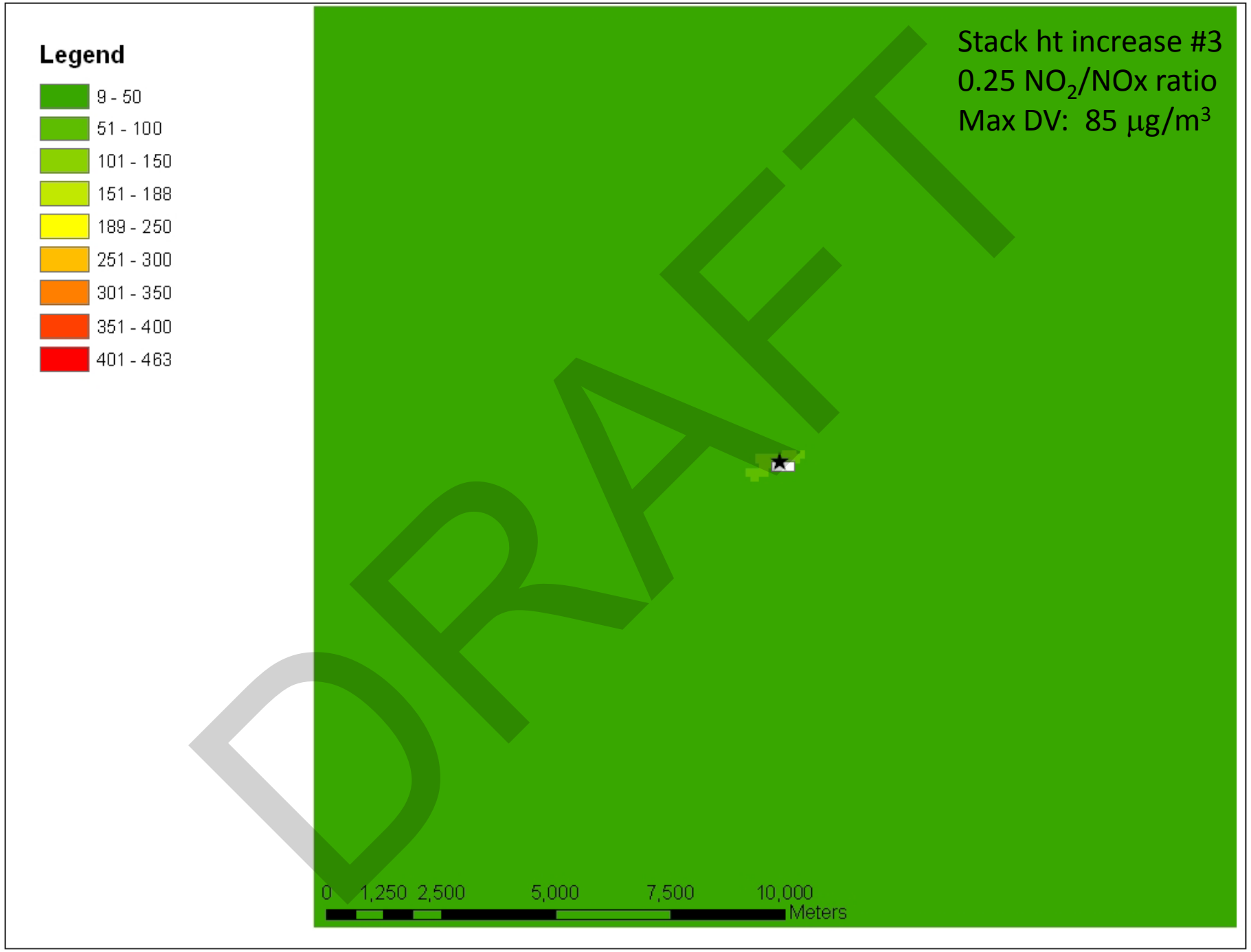

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #1
0.1 NO2/NOx ratio
Max DV: 106 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

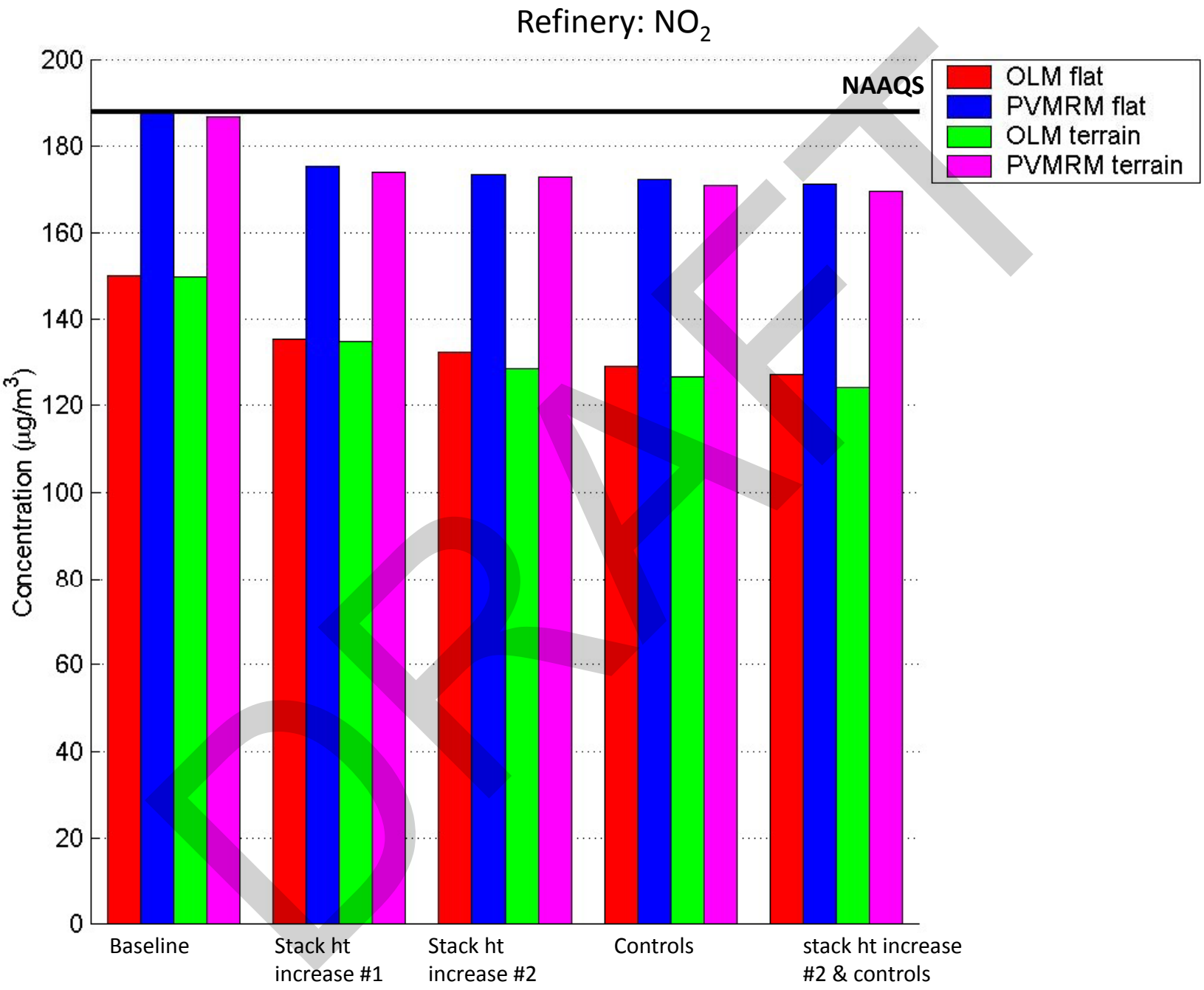

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #1
0.25 NO2/NOx ratio
Max DV: 110 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

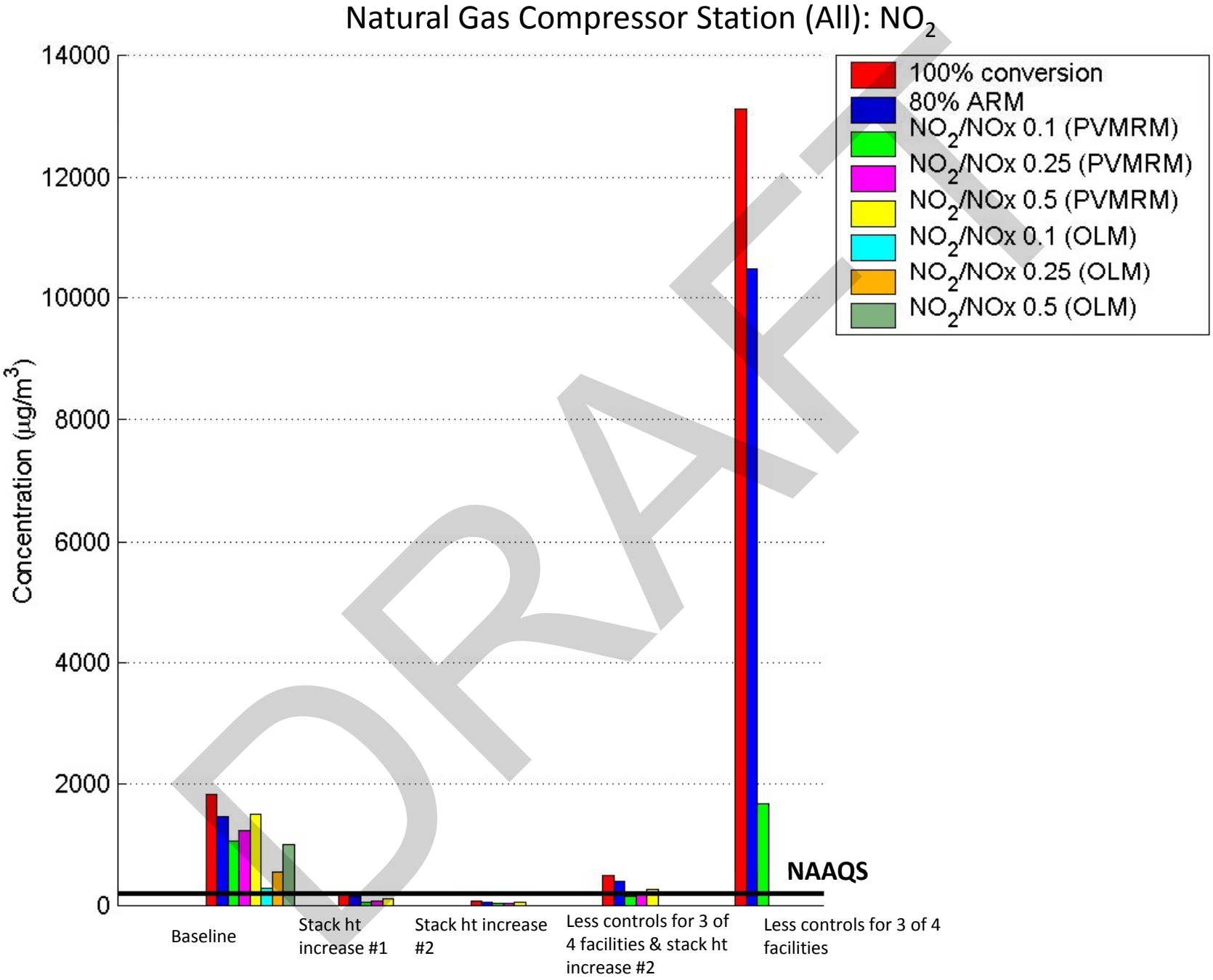

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #2
0.1 NO2/NOx ratio
Max DV: 86 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

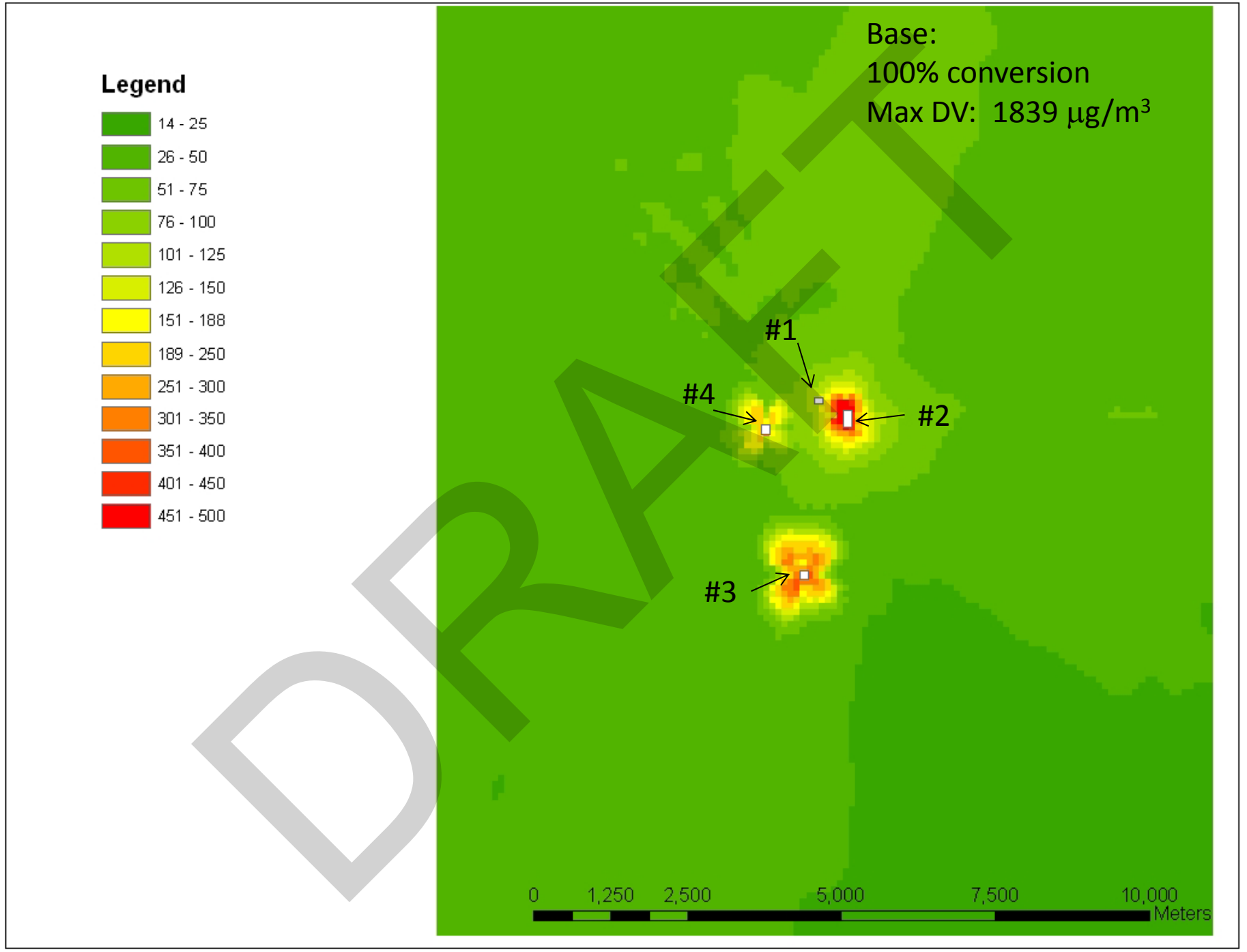

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #2
0.25 NO2/NOx ratio
Max DV: 88 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

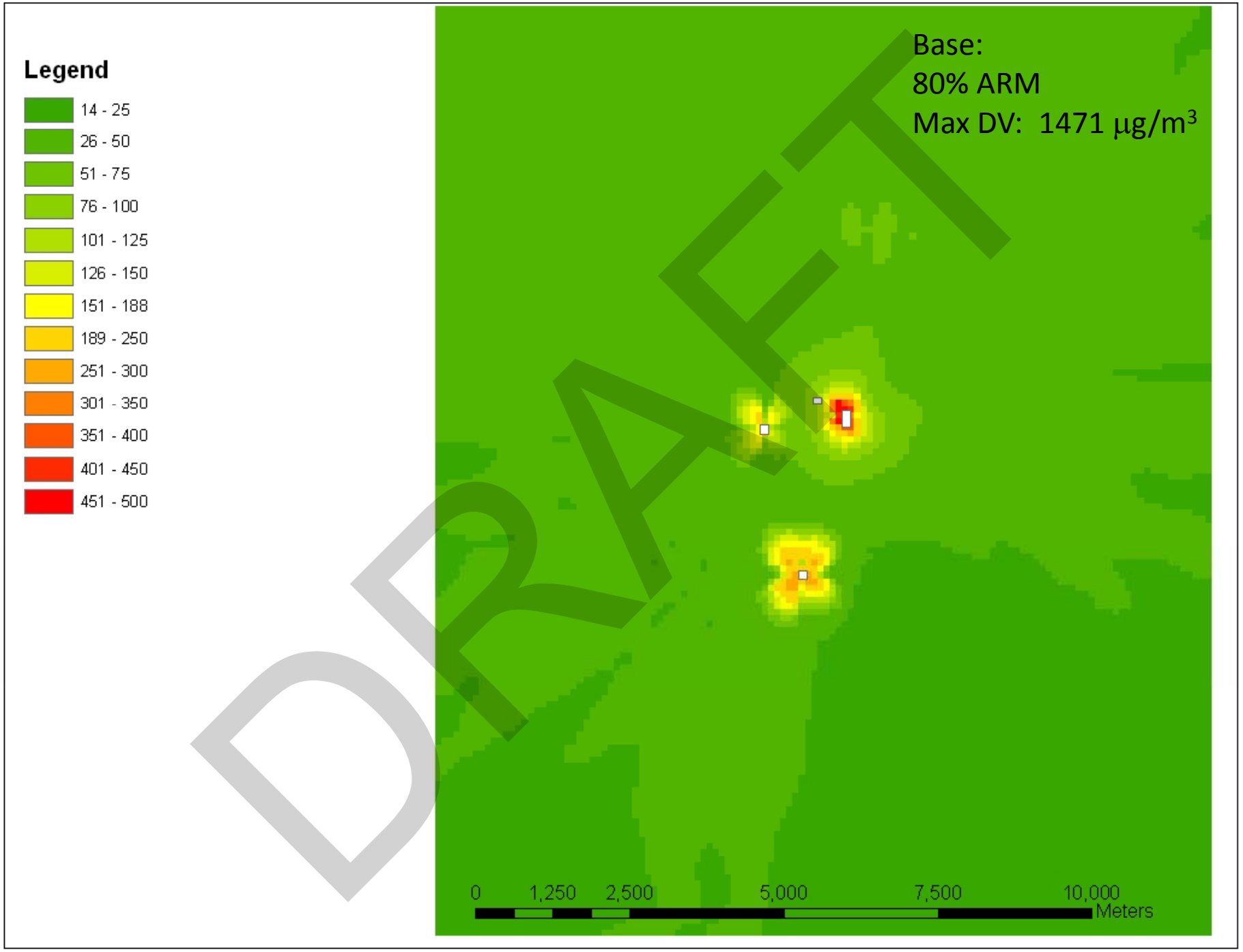

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #3
0.1 NO2/NOx ratio
Max DV: 85 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

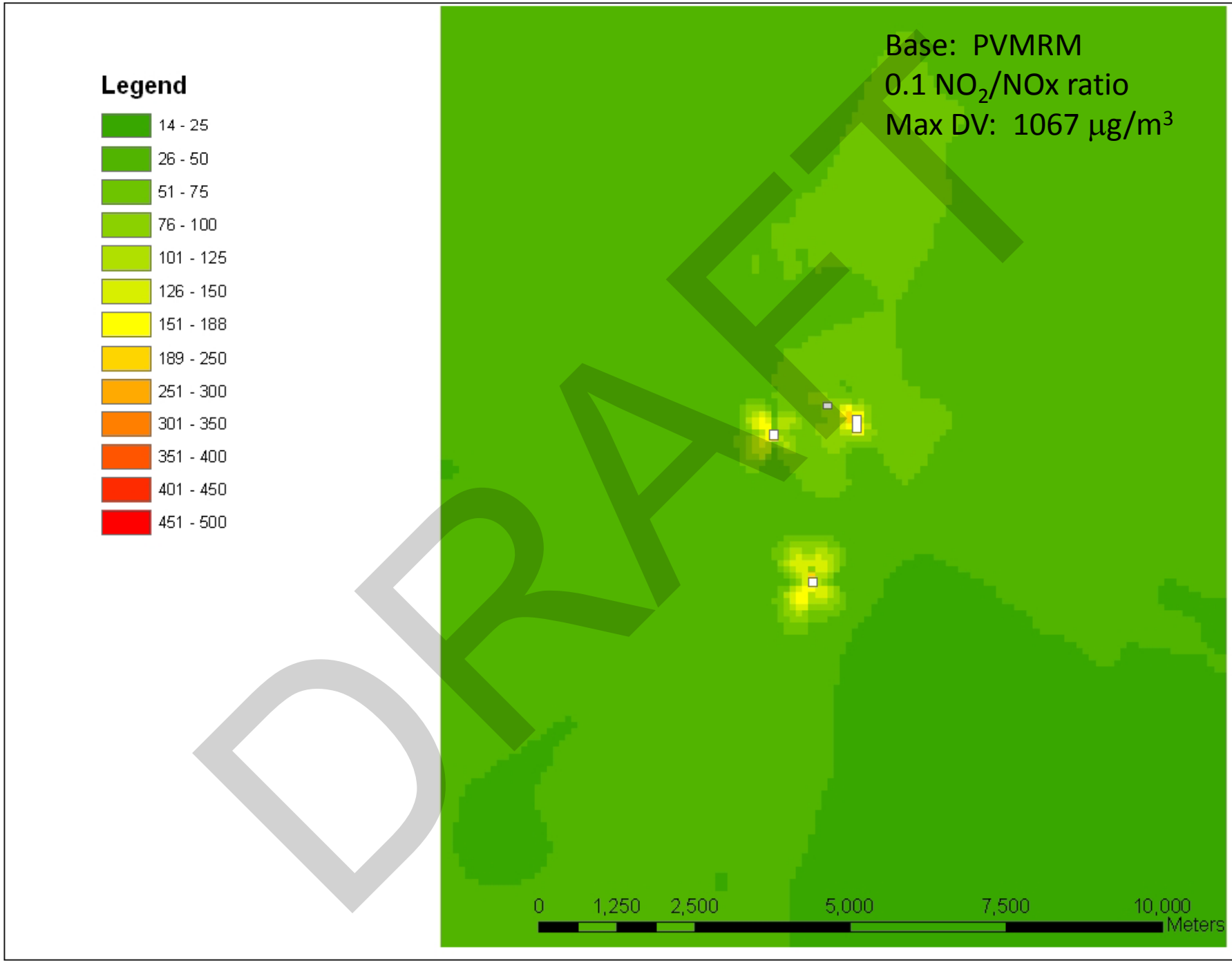

Legend
9 - 50
51 - 100
101 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 463
Stack ht increase #3
0.25 NO2/NOx ratio
Max DV: 85 µg/m3
DRAFT
0 1,250 2,500 5,000 7,500 10,000
Meters

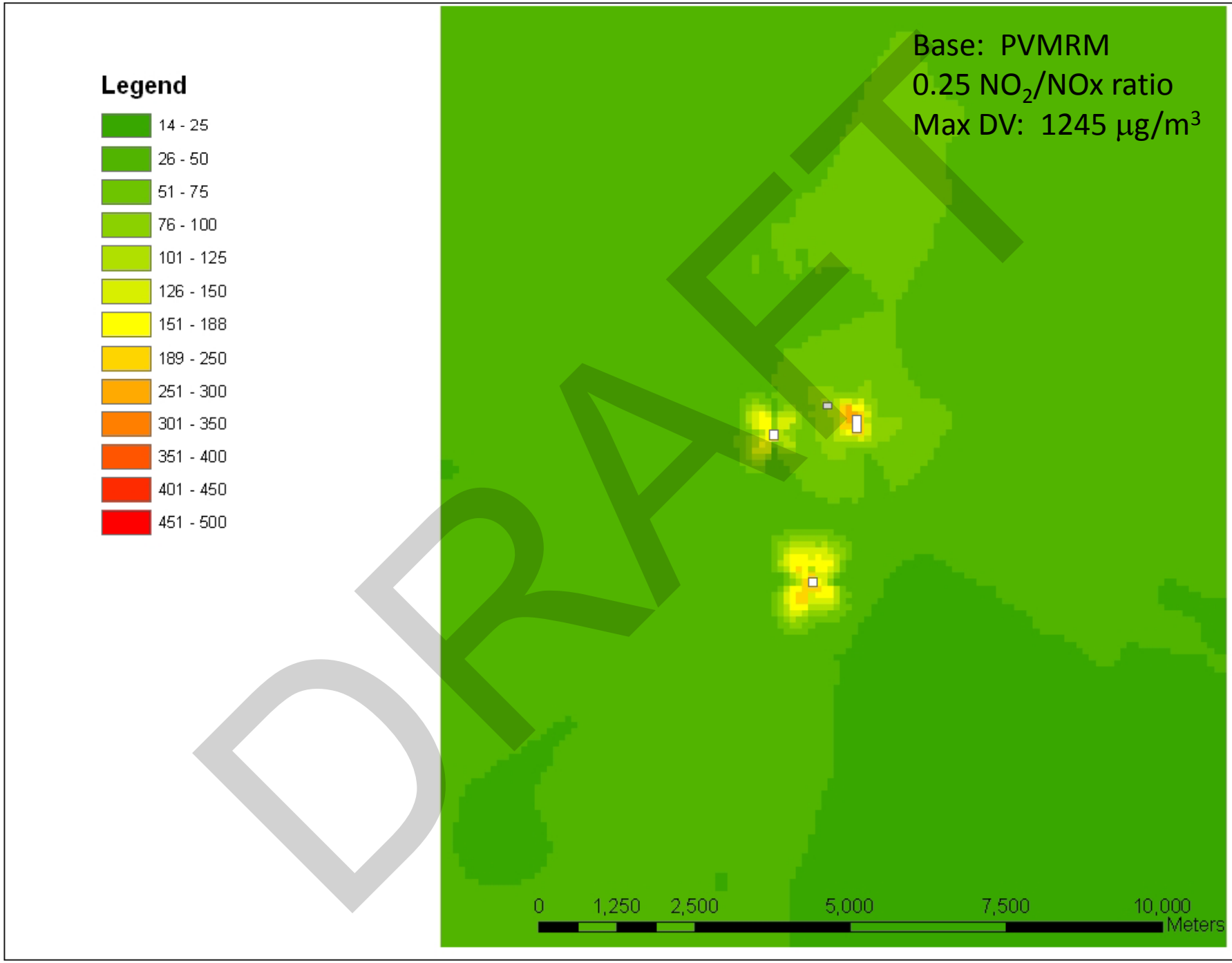

Refinery: NO2
NAAQS
OLM flat
PVMRM flat
OLM terrain
PVMRM terrain
Concentration (µg/m3)
200
180
160
140
120
100
80
60
40
20
0
Baseline
Stack ht increase #1
Stack ht increase #2
Controls
stack ht increase #2 & controls

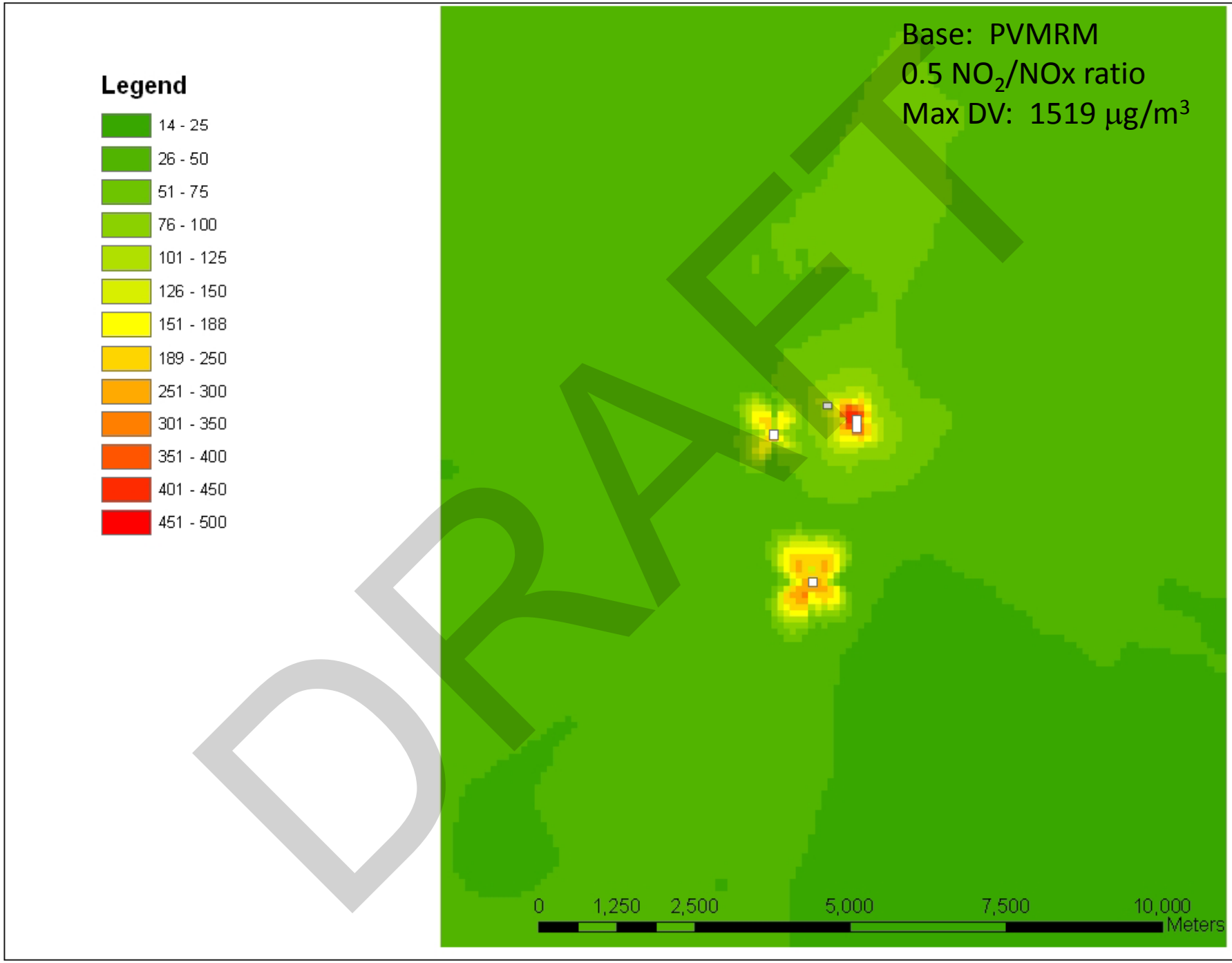

Natural Gas Compressor Station (All): NO2
14000
12000
10000
8000
6000
4000
2000
0
Concentration (µg/m3)
100% conversion
80% ARM
NO2/NOx 0.1 (PVMRM)
NO2/NOx 0.25 (PVMRM)
NO2/NOx 0.5 (PVMRM)
NO2/NOx 0.1 (OLM)
NO2/NOx 0.25 (OLM)
NO2/NOx 0.5 (OLM)
NAAQS
Baseline
Stack ht increase #1
Stack ht increase #2
Less controls for 3 of 4 facilities & stack ht increase #2
Less controls for 3 of 4 facilities

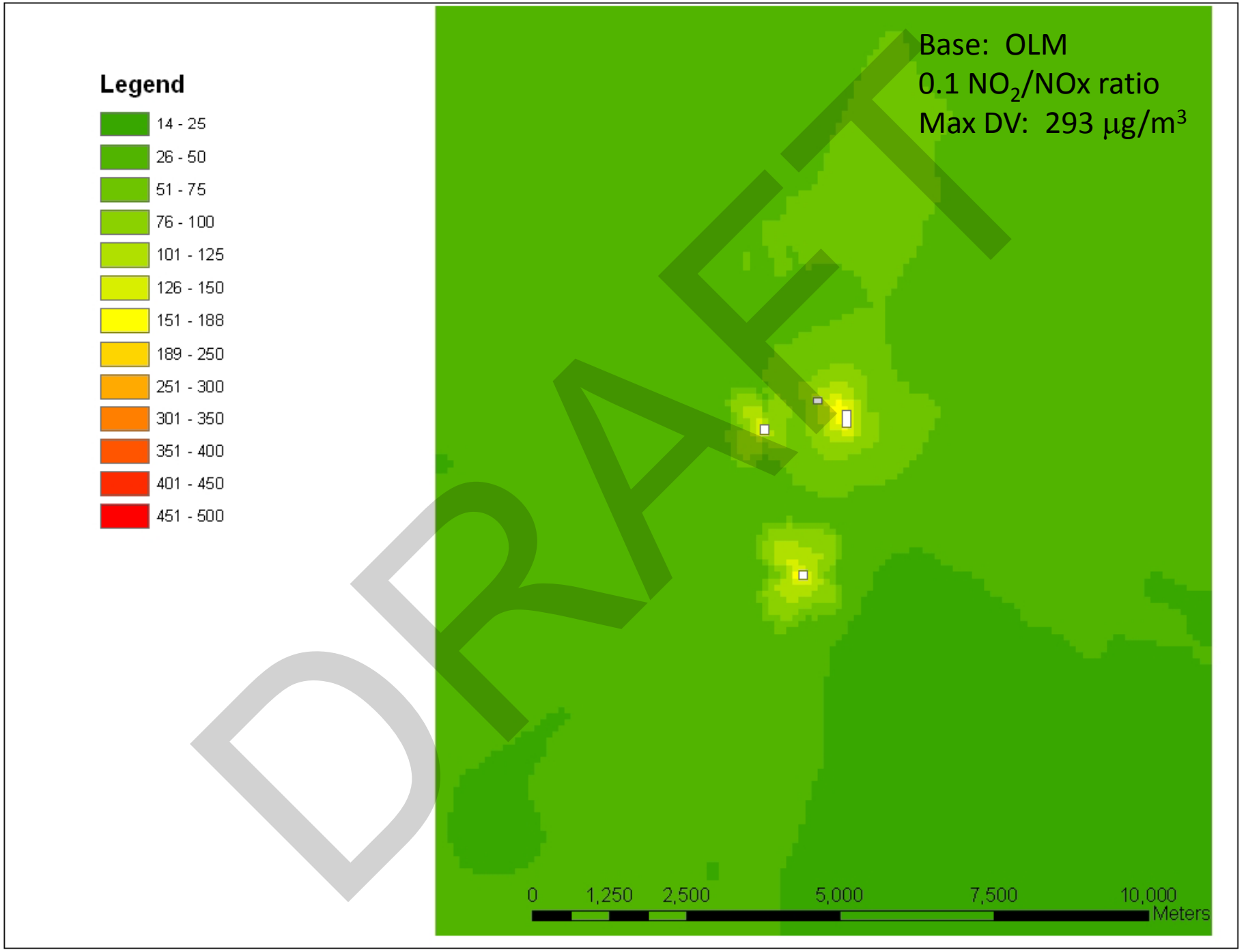

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base:
100% conversion
Max DV: 1839 µg/m³
#1
#2
#3
#4
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

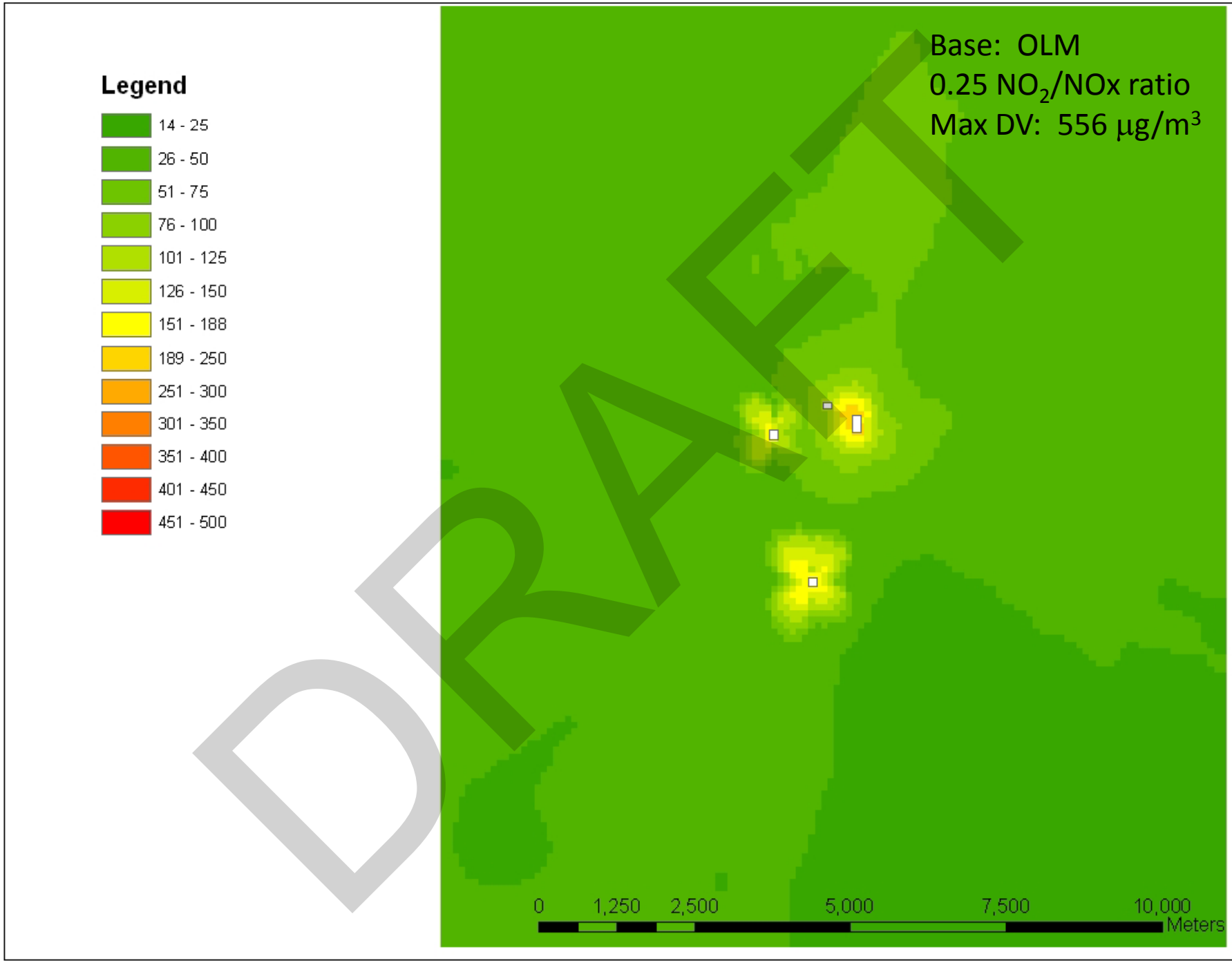

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base:
80% ARM
Max DV: 1471 µg/m3
DRAFT
0
1,250
2,500
5,000
7,500
10,000
Meters

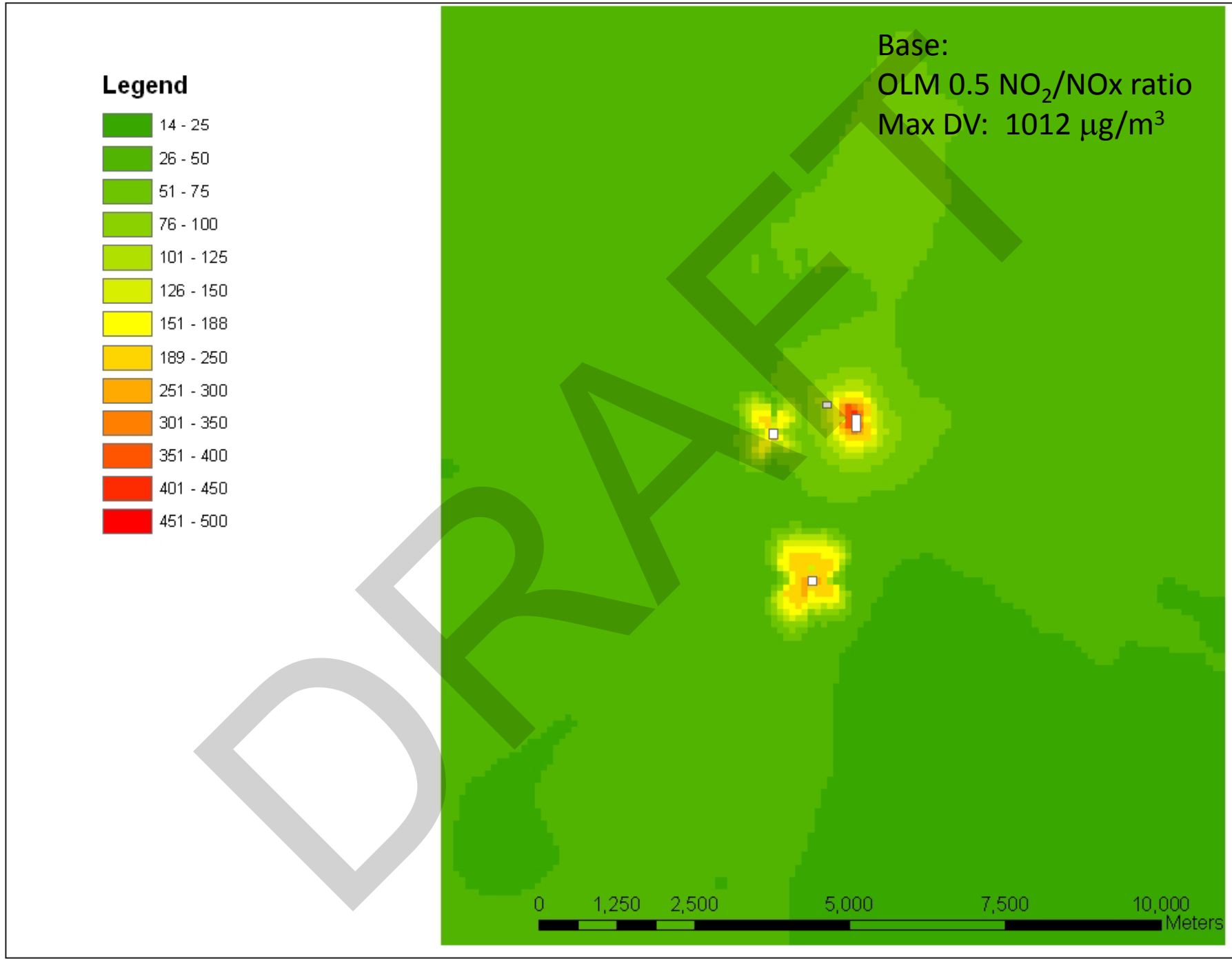

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base: PVMRM
0.1 NO2/NOx ratio
Max DV: 1067 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

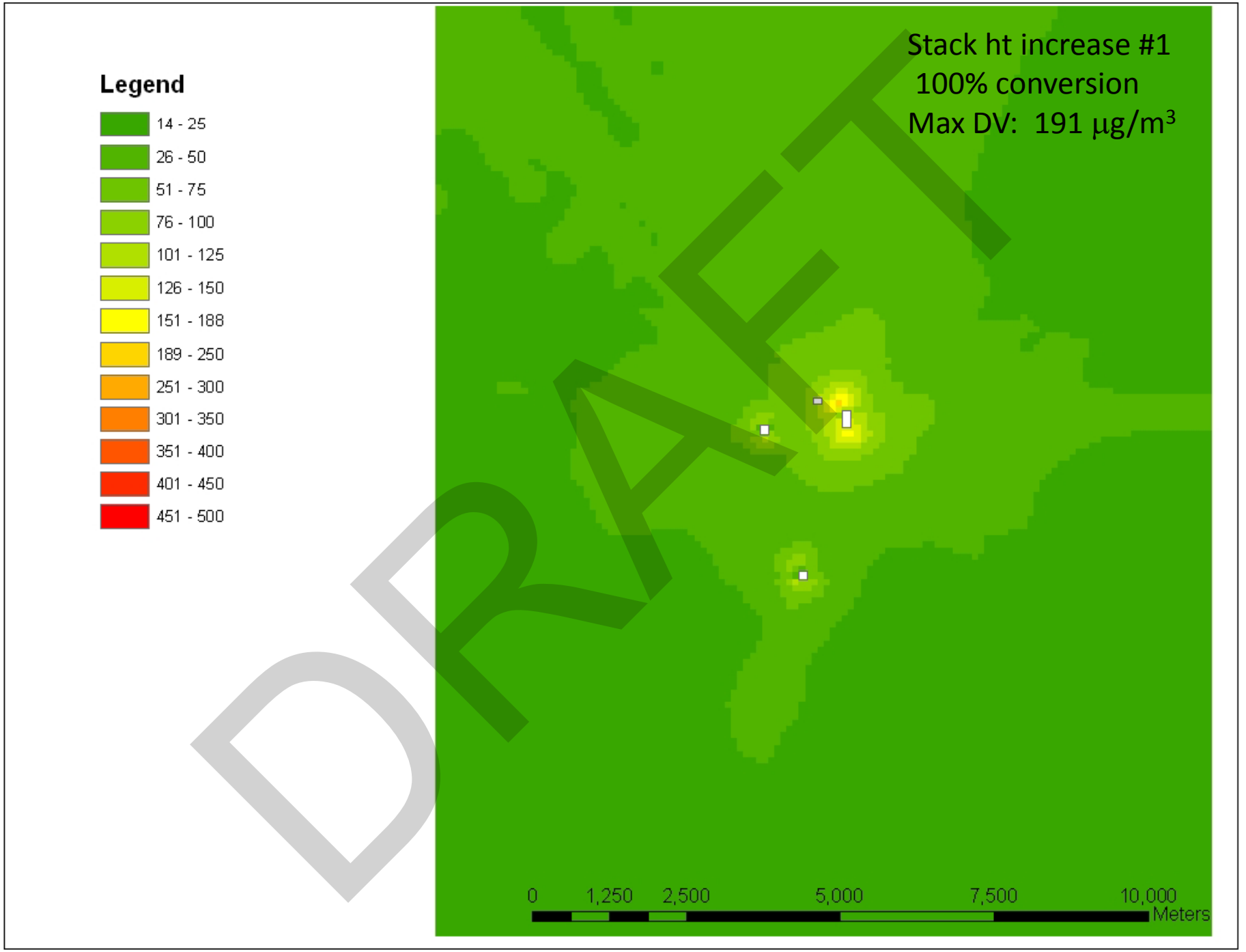

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base: PVMRM
0.25 NO2/NOx ratio
Max DV: 1245 µg/m3
DRAFT
0
1,250
2,500
5,000
7,500
10,000
Meters

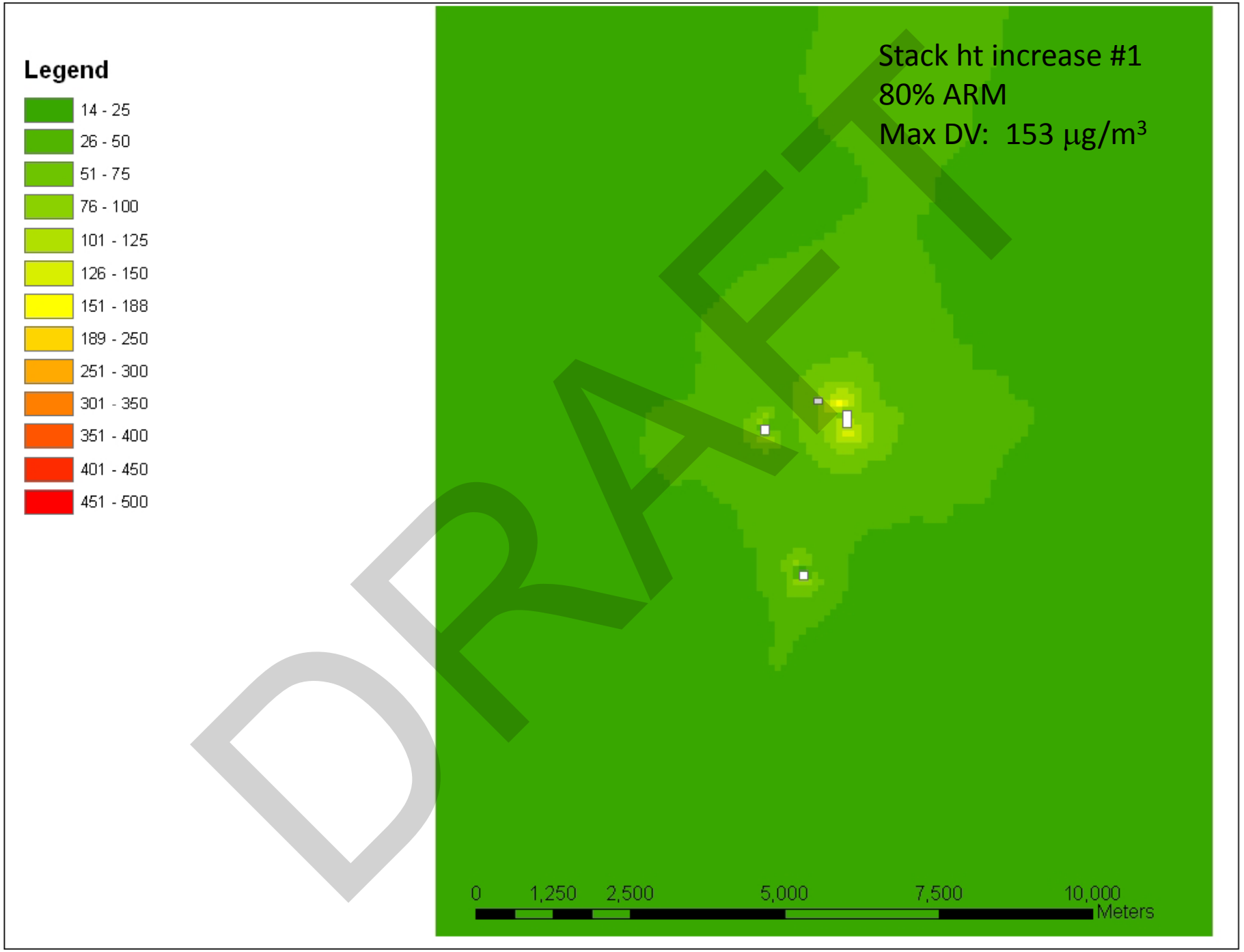

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base: PVMRM
0.5 NO2/NOx ratio
Max DV: 1519 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

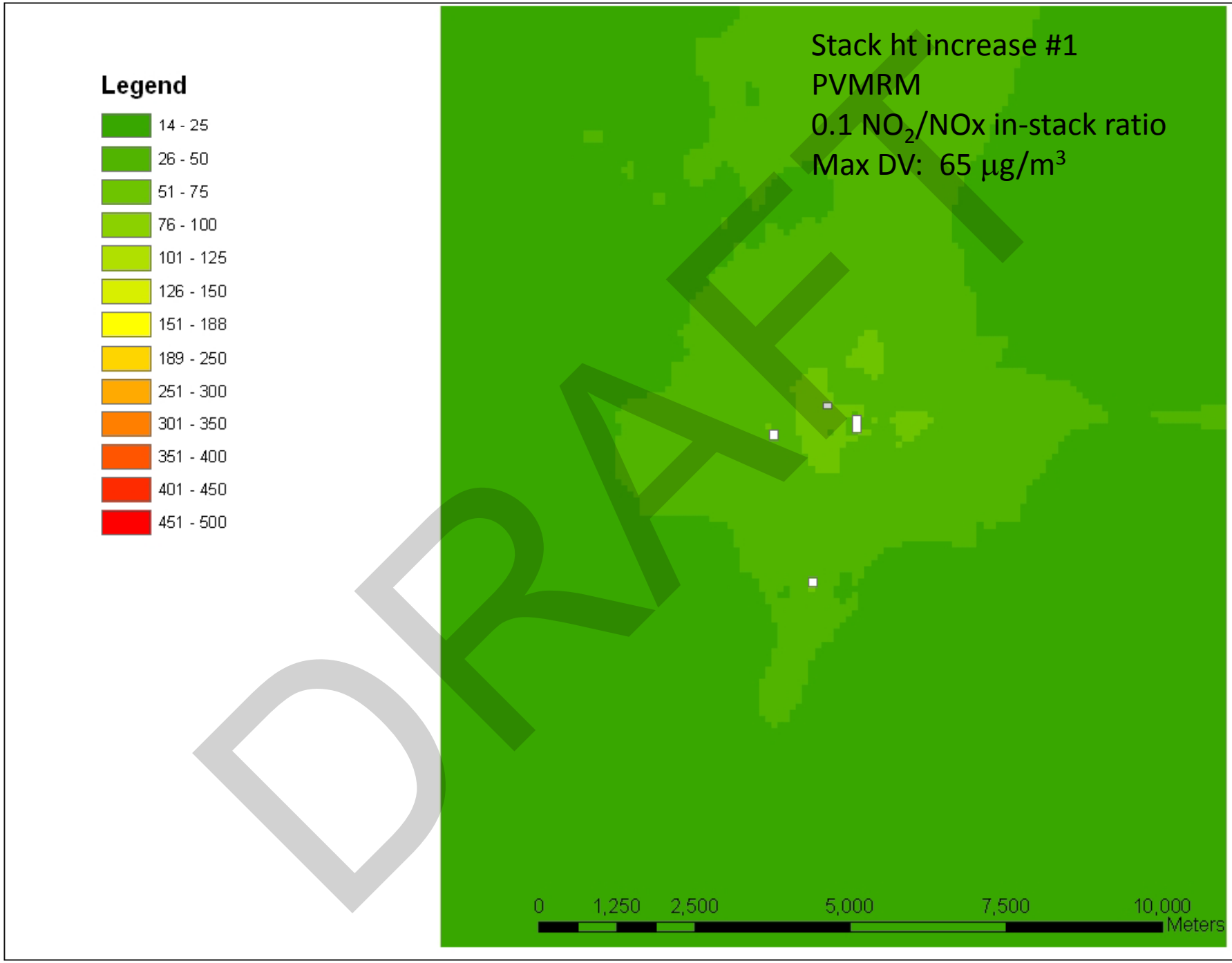

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base: OLM
0.1 NO2/NOx ratio
Max DV: 293 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

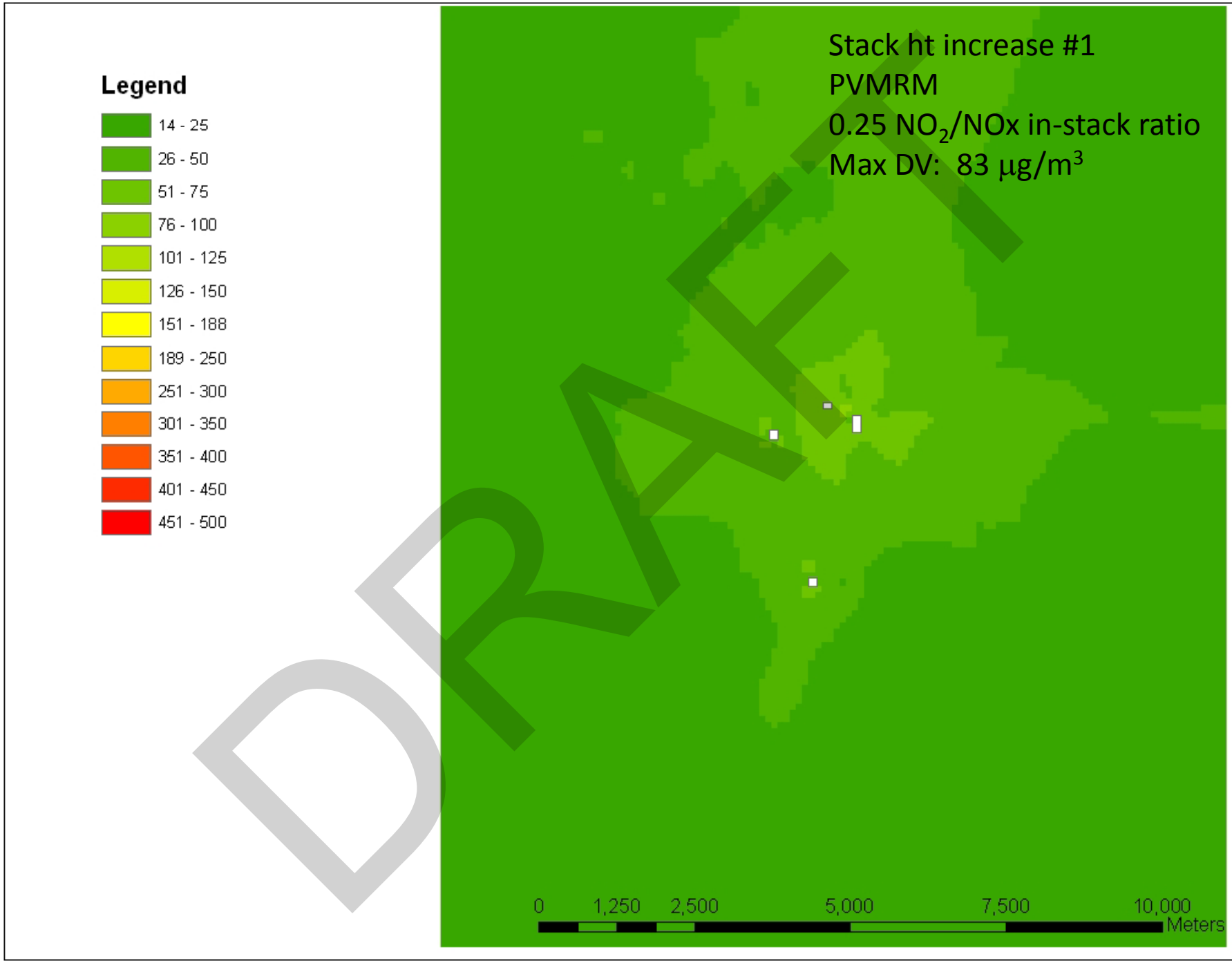

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base: OLM
0.25 NO2/NOx ratio
Max DV: 556 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

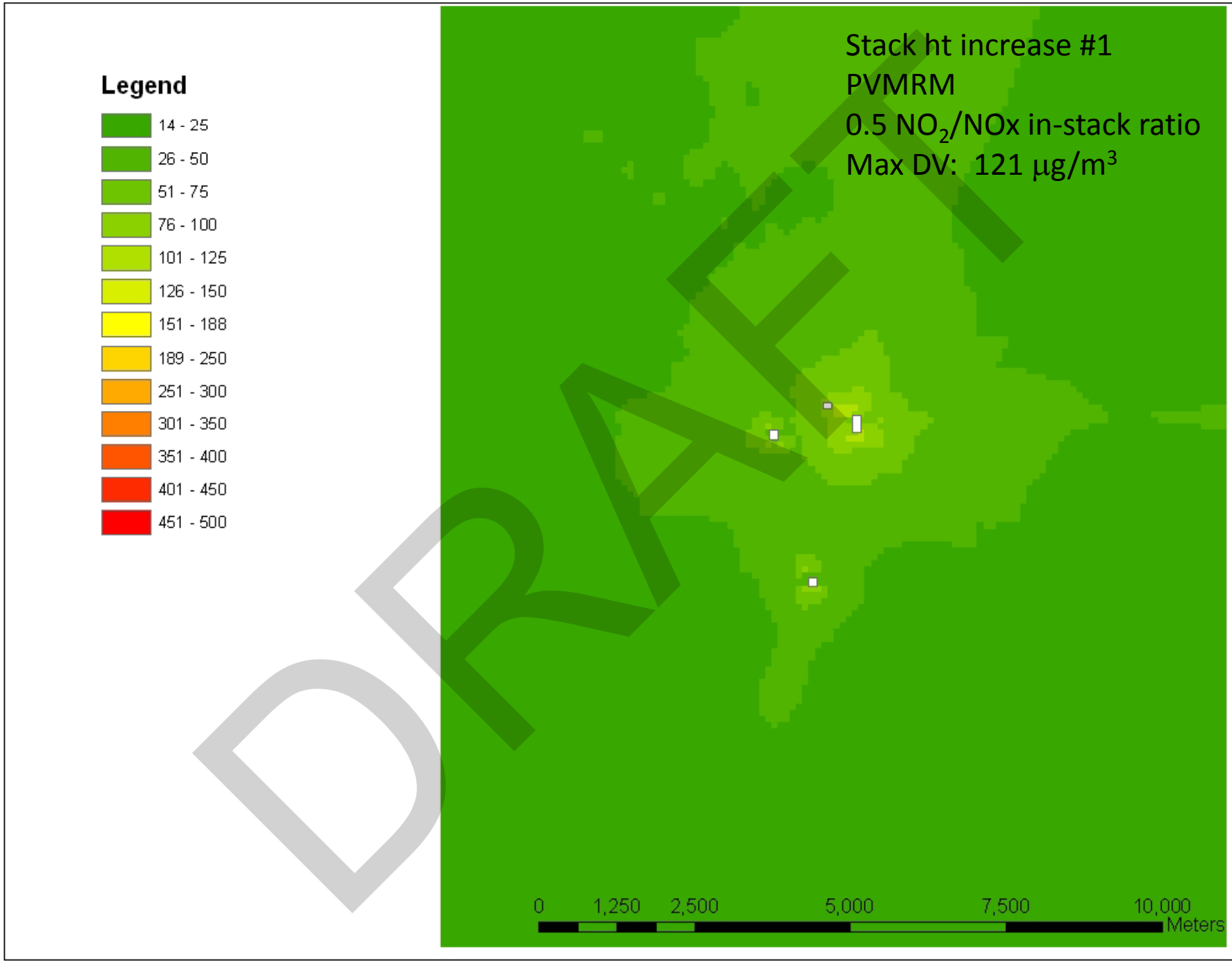

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Base:
OLM 0.5 NO2/NOx ratio
Max DV: 1012 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

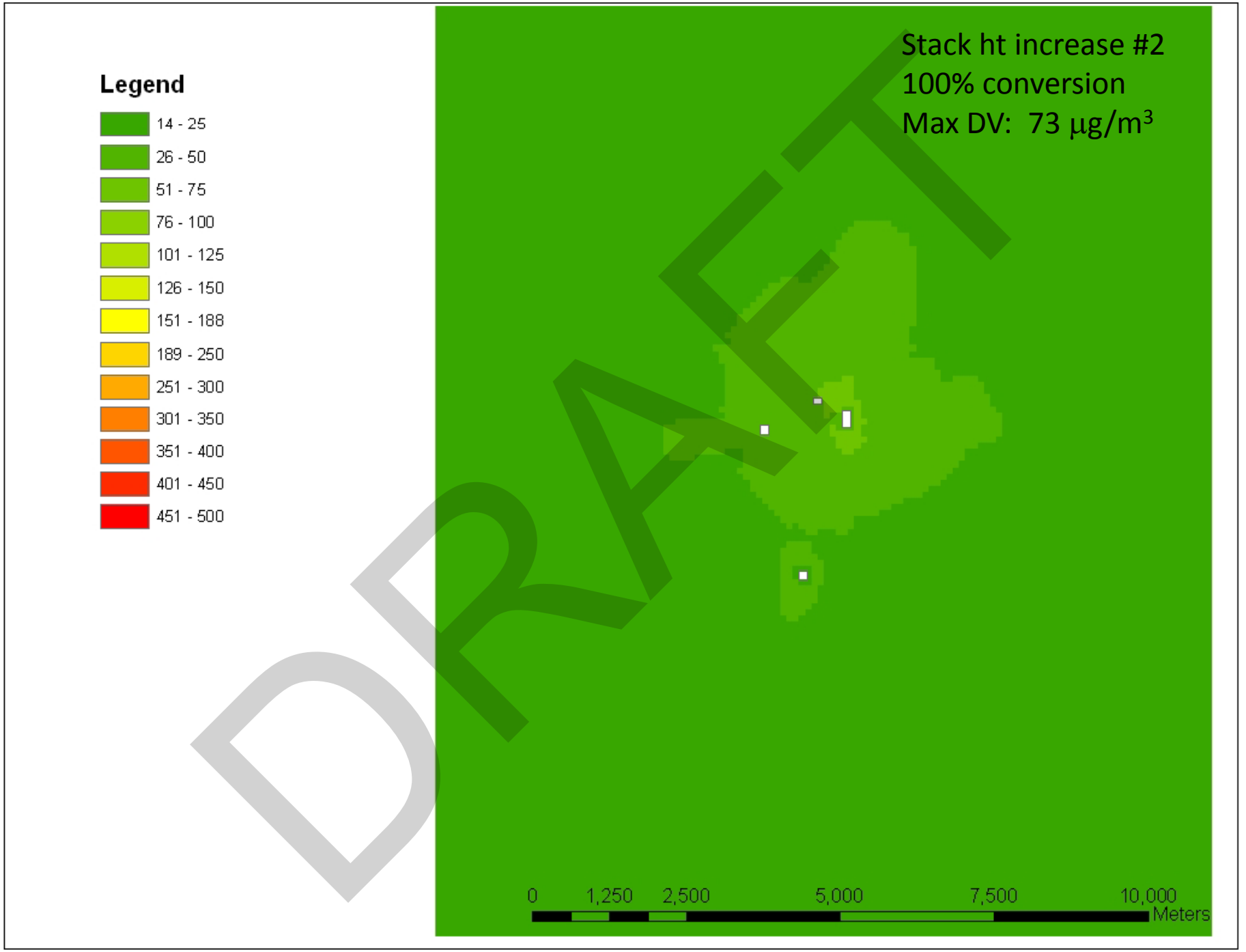

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #1
100% conversion
Max DV: 191 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

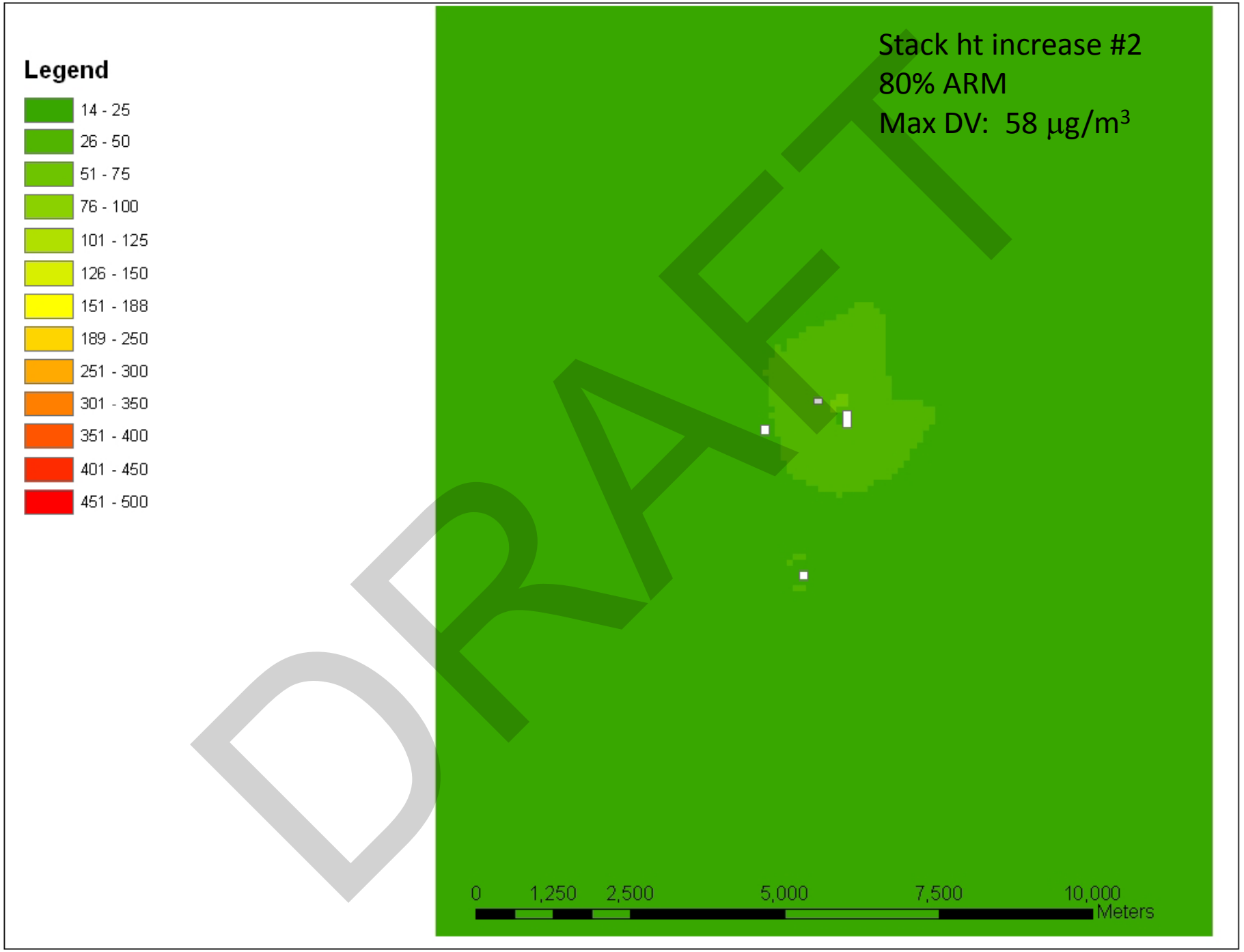

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #1
80% ARM
Max DV: 153 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

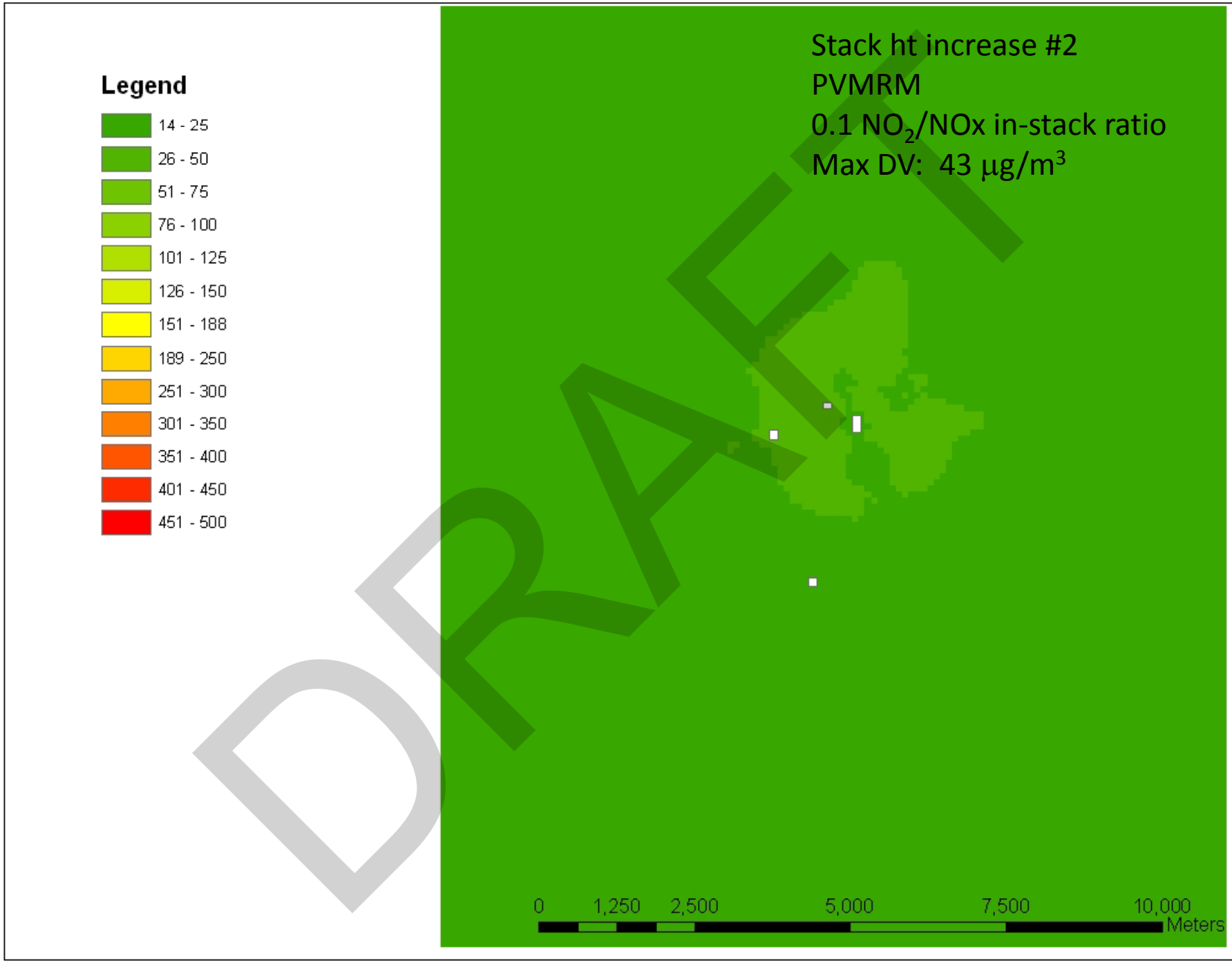

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #1
PVMRM
0.1 NO2/NOx in-stack ratio
Max DV: 65 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

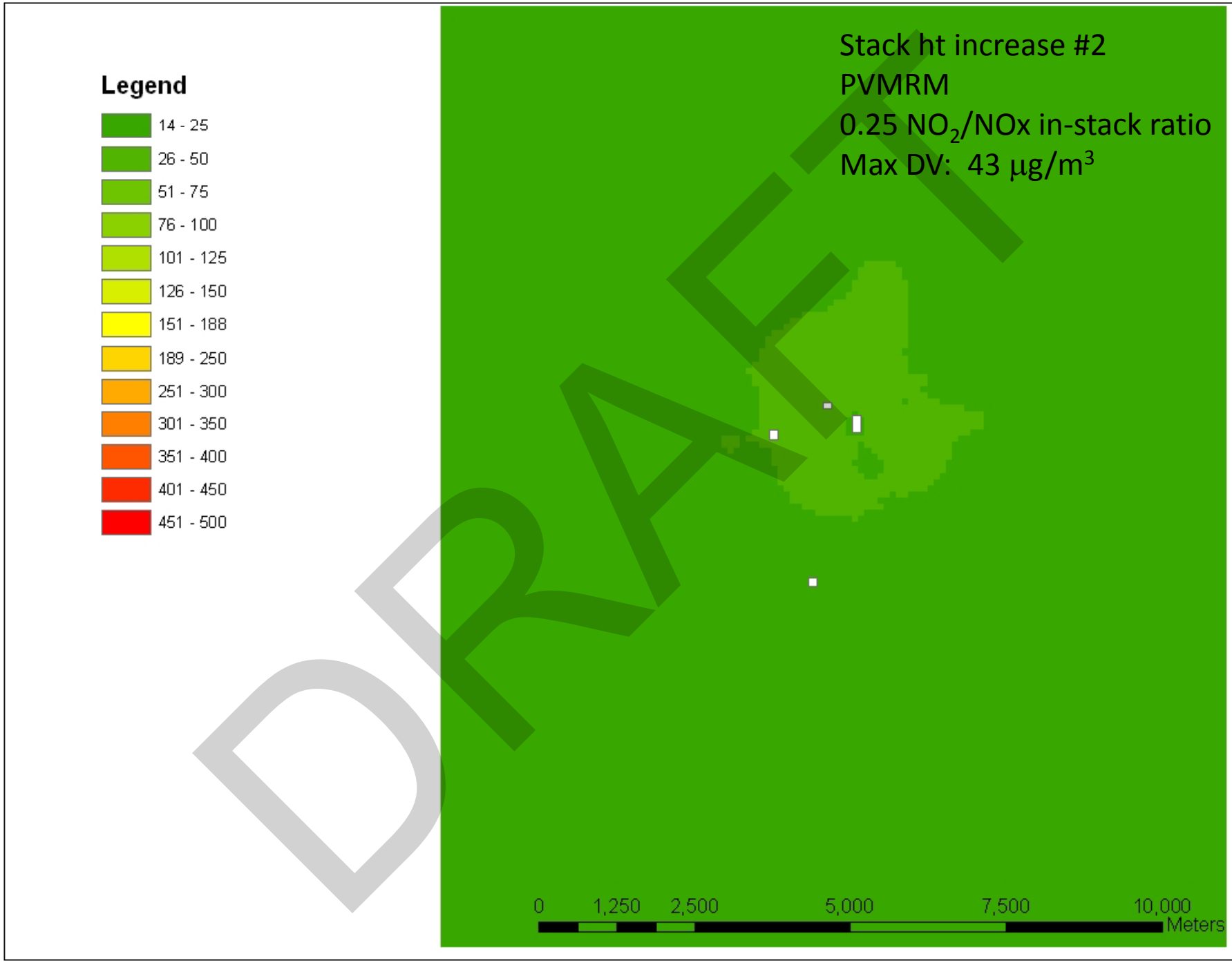

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #1
PVMRM
0.25 NO2/NOx in-stack ratio
Max DV: 83 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

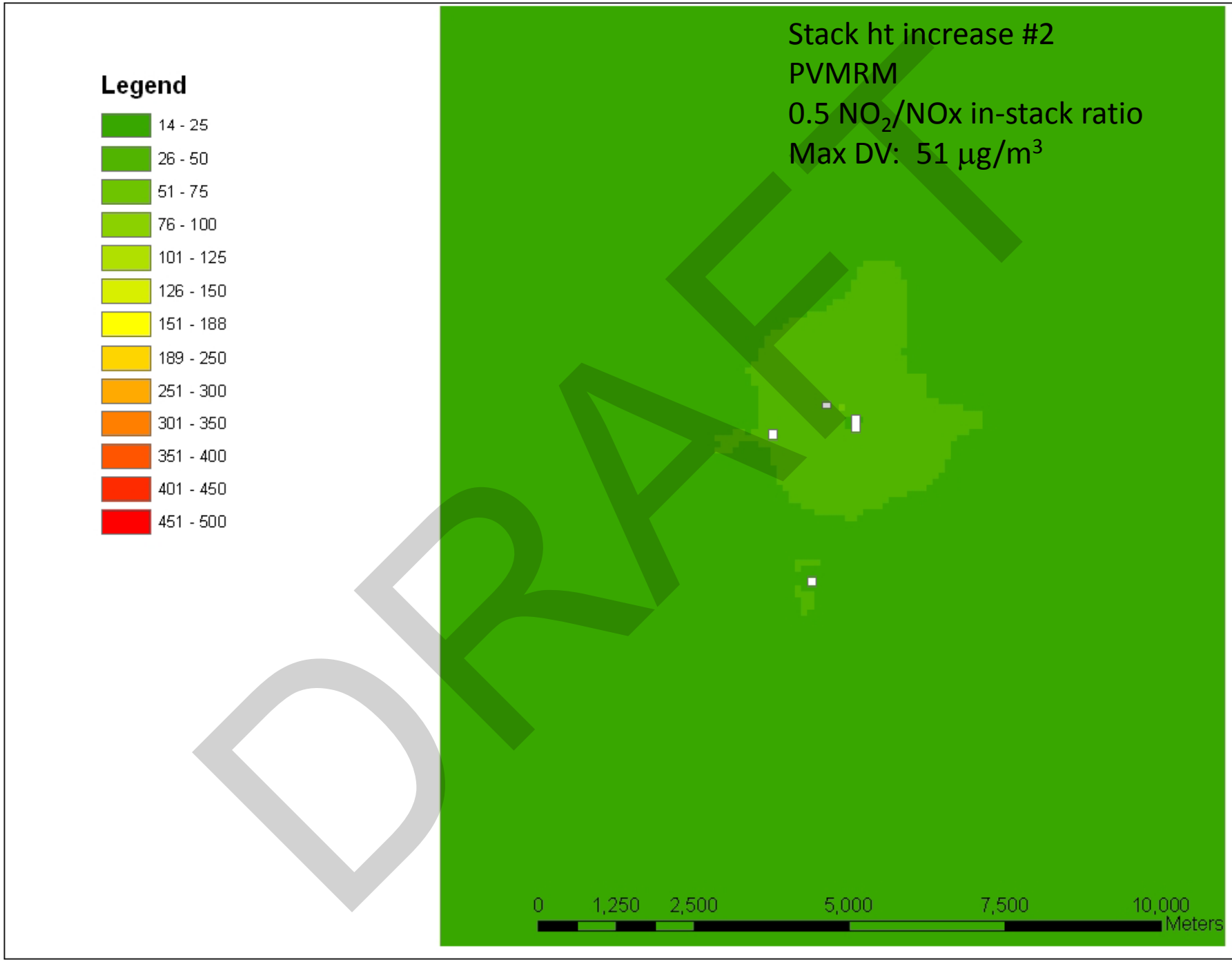

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #1
PVMRM
0.5 NO2/NOx in-stack ratio
Max DV: 121 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

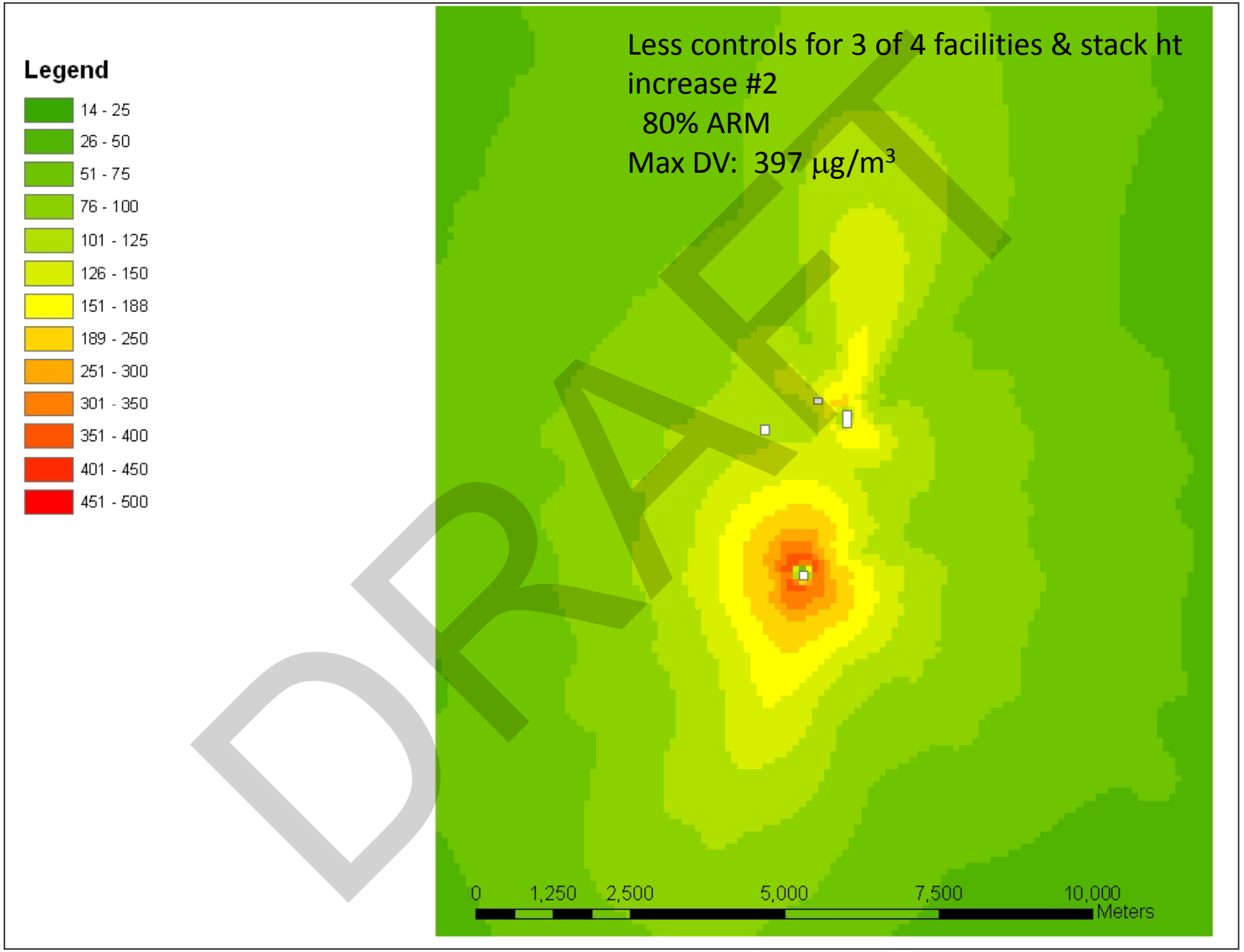

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #2
100% conversion
Max DV: 73 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

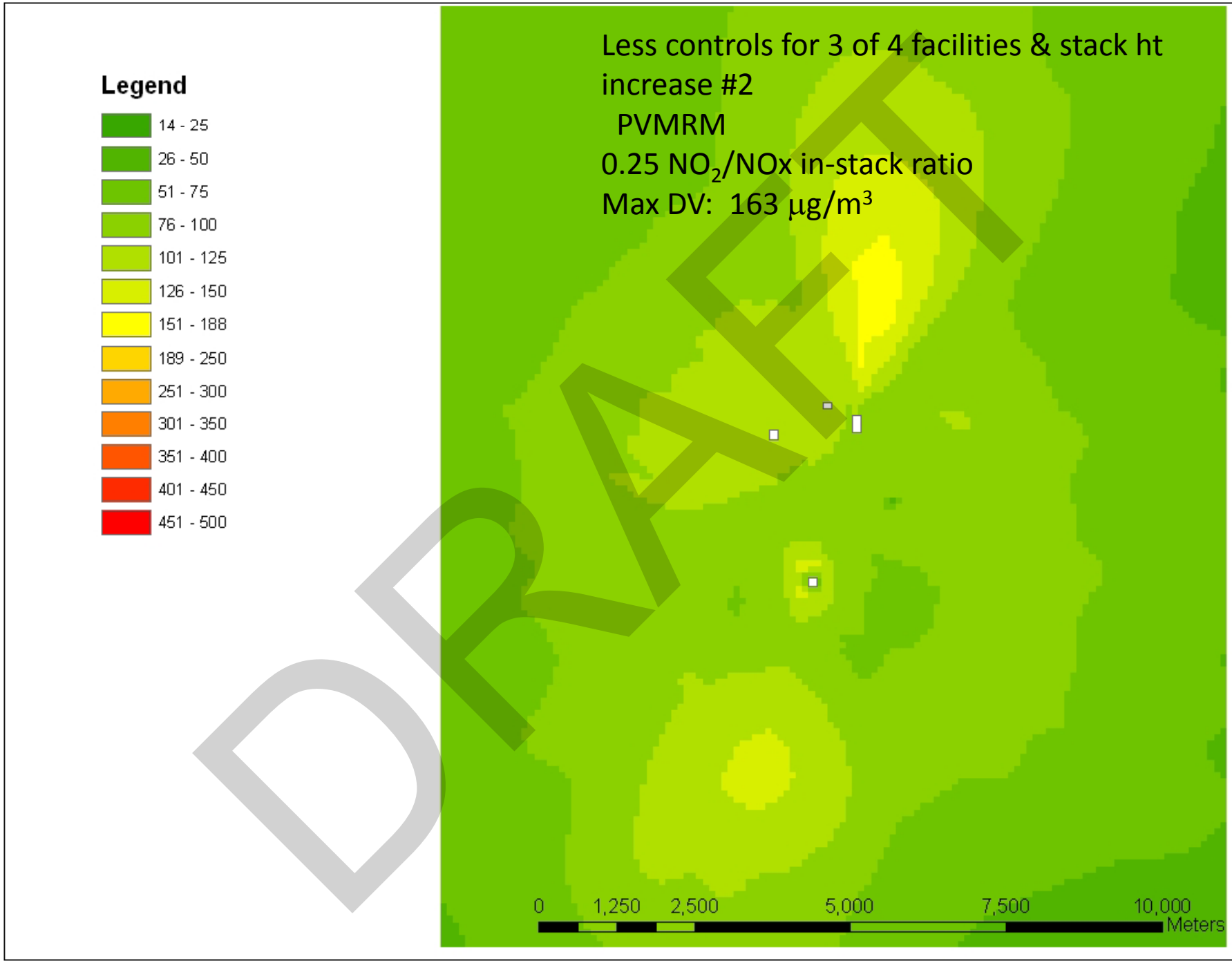

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #2
80% ARM
Max DV: 58 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

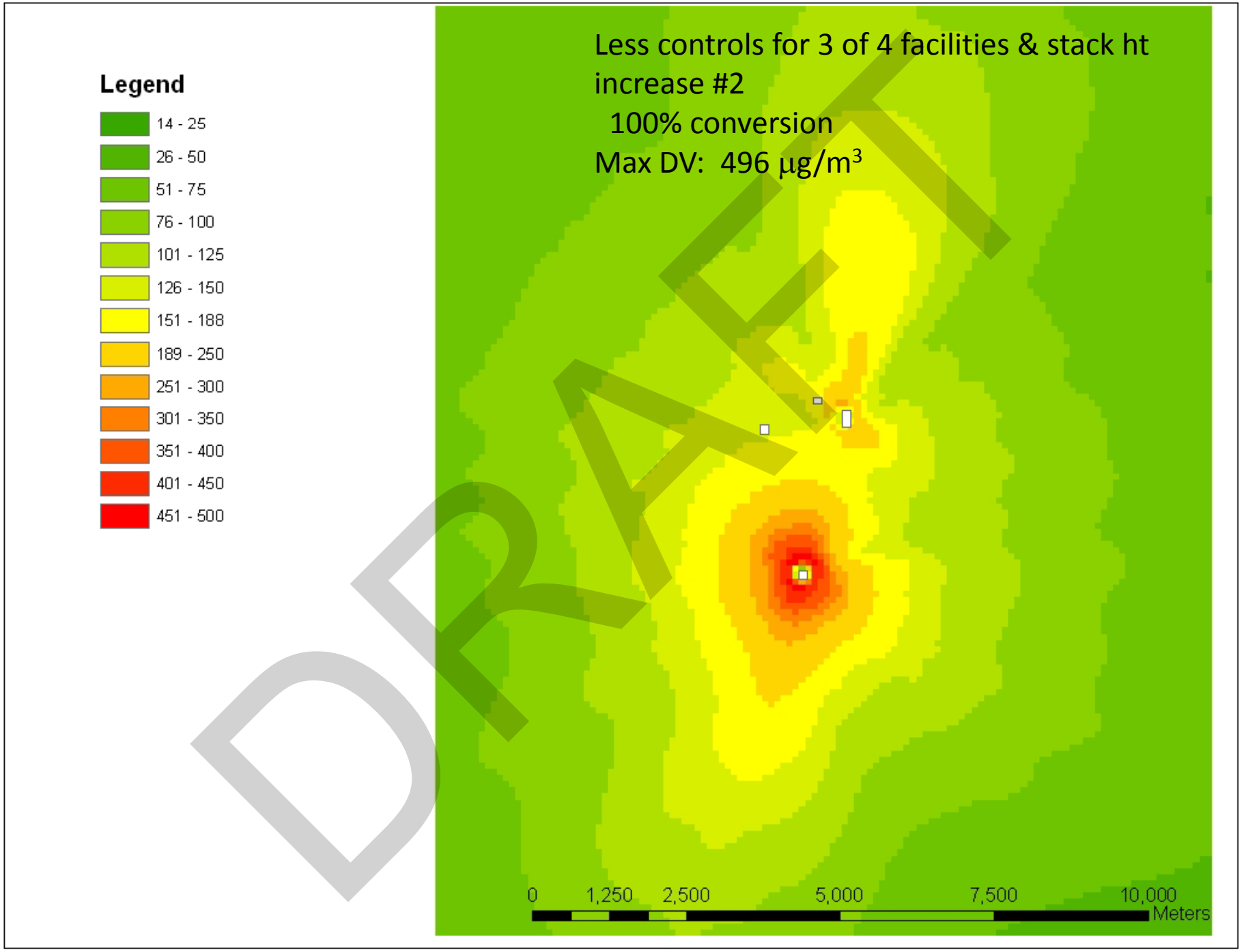

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #2
PVMRM
0.1 NO2/NOx in-stack ratio
Max DV: 43 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters

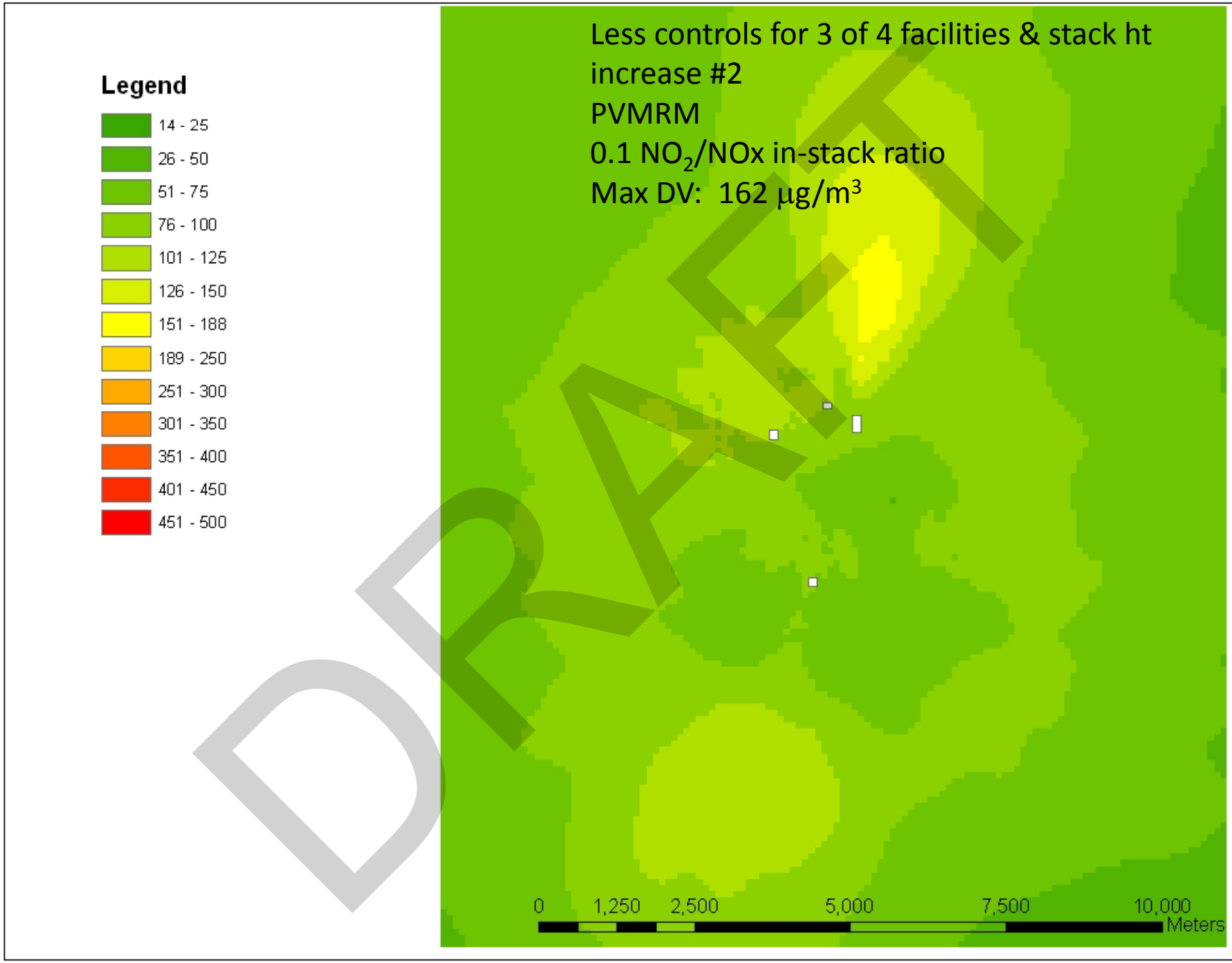

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #2
PVMRM
0.25 NO2/NOx in-stack ratio
Max DV: 43 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

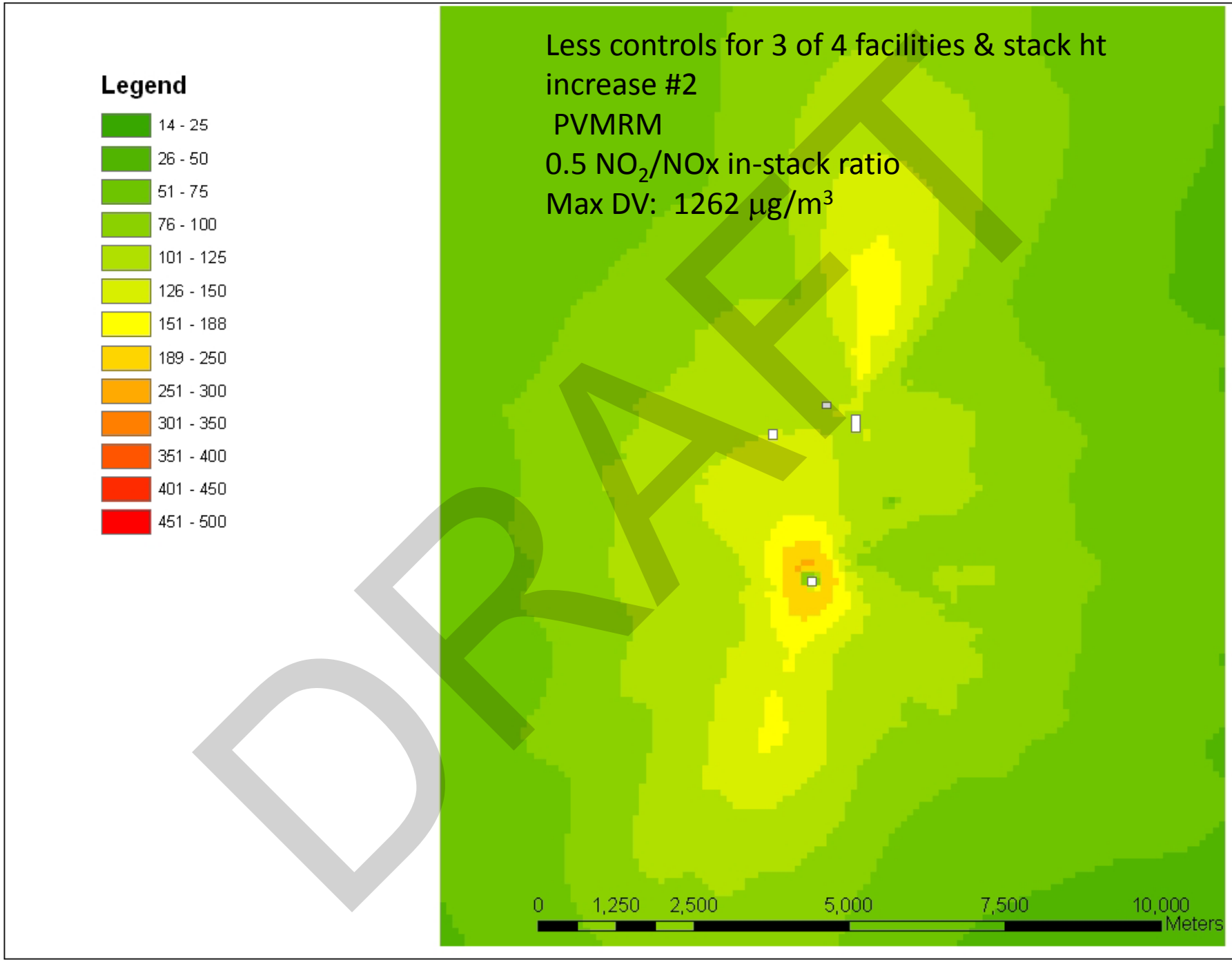

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Stack ht increase #2
PVMRM
0.5 NO2/NOx in-stack ratio
Max DV: 51 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

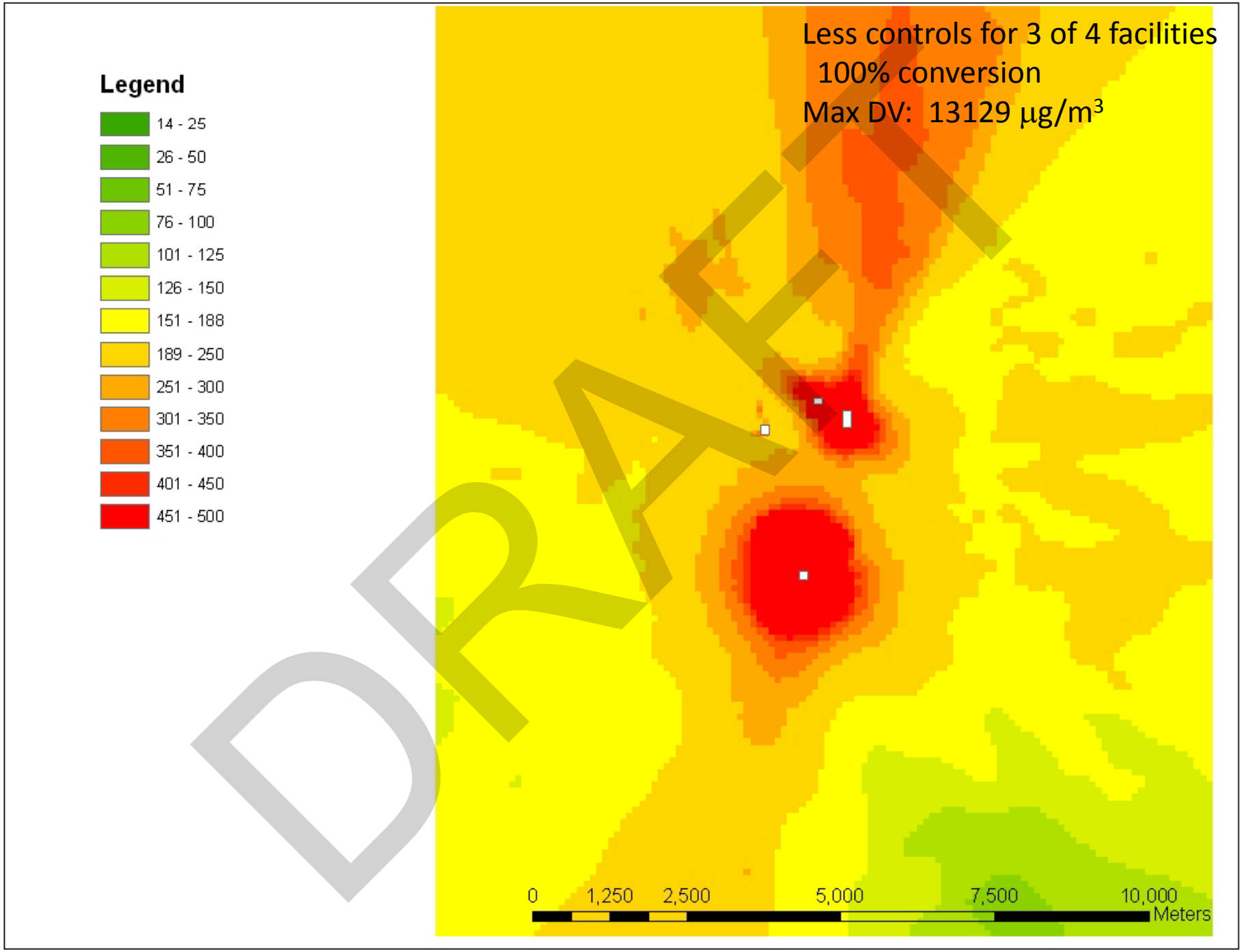

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities & stack ht increase #2
80% ARM
Max DV: 397 µg/m3
DRAFT
0
1,250
2,500
5,000
7,500
10,000
Meters

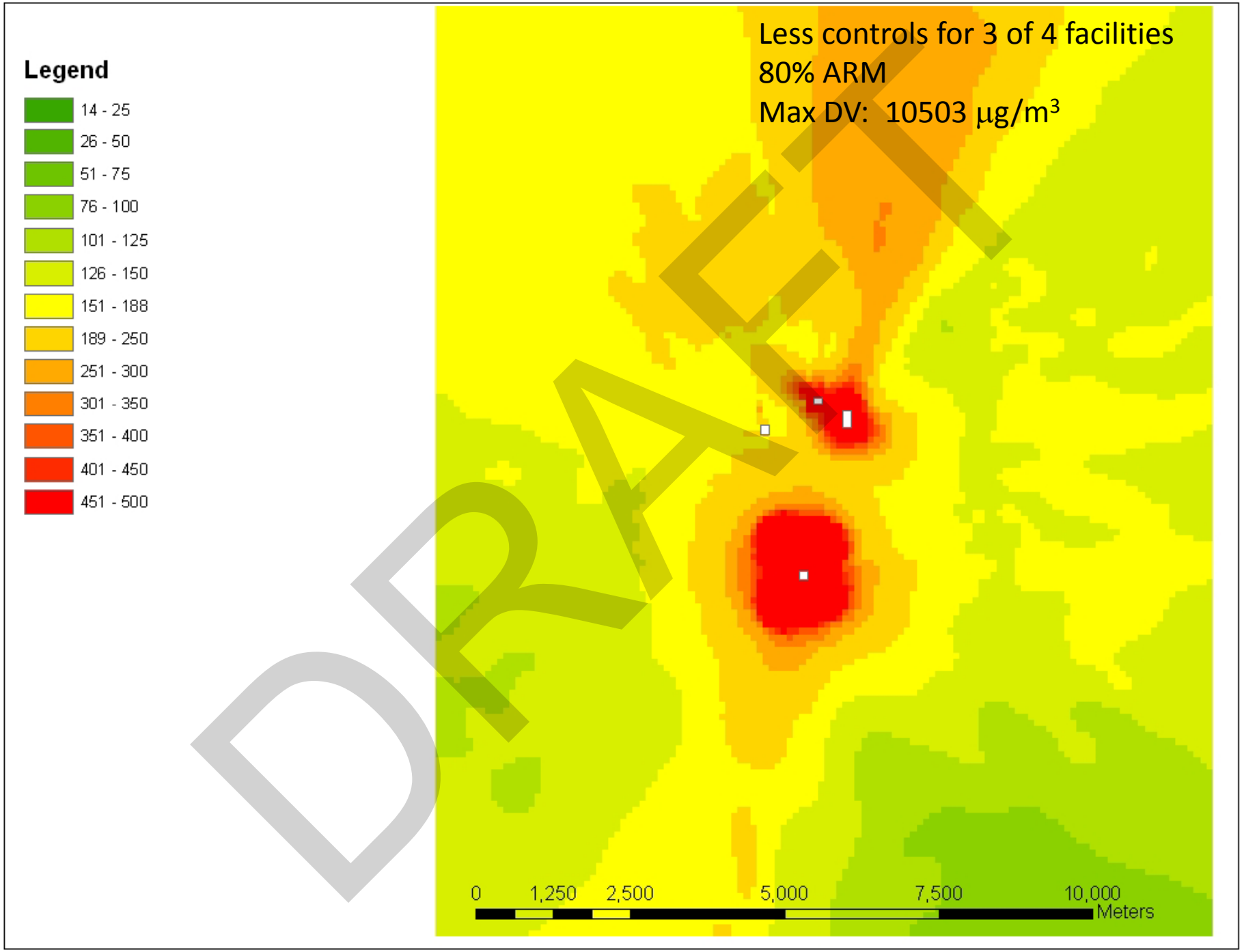

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities & stack ht increase #2
PVMRM
0.25 NO2/NOx in-stack ratio
Max DV: 163 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

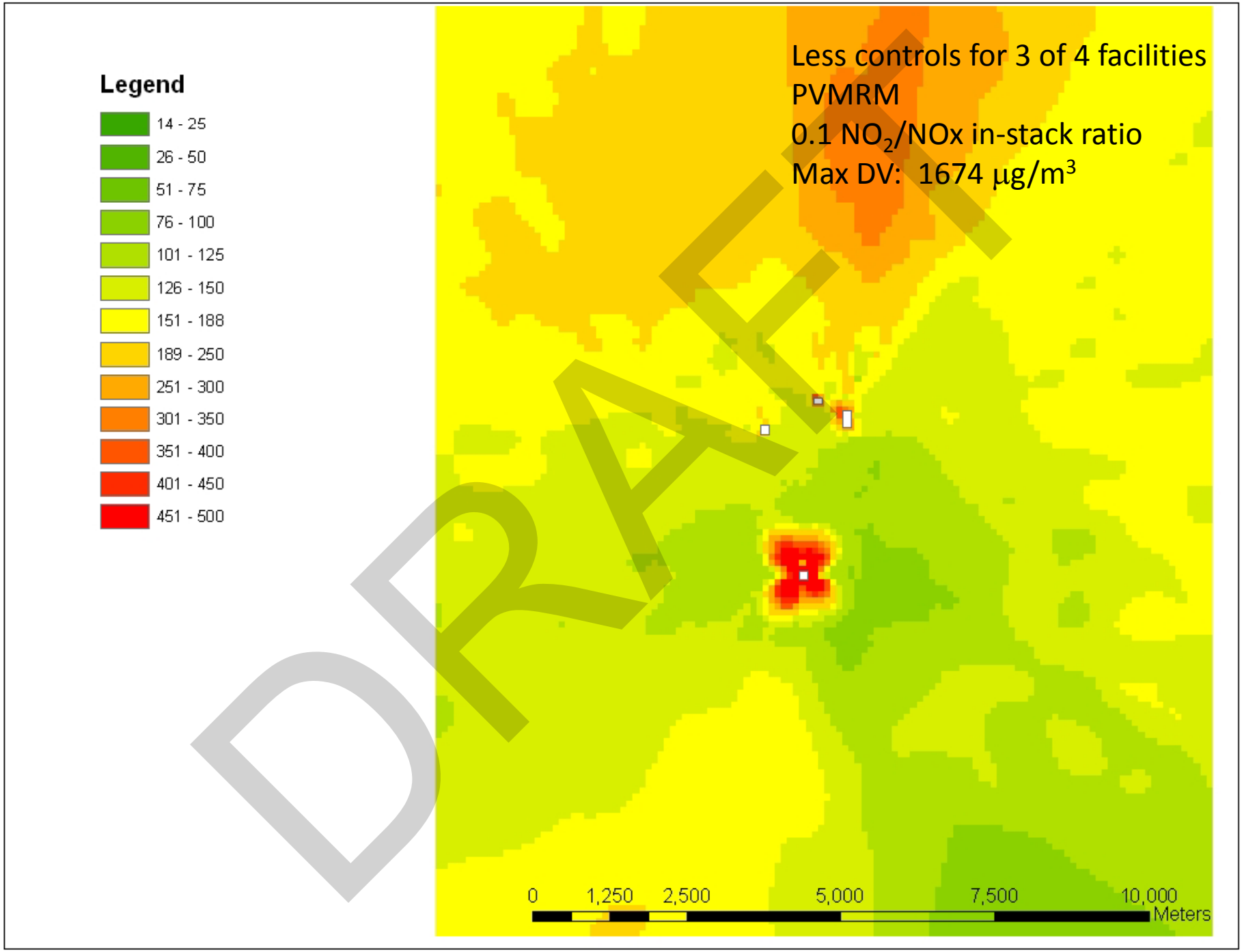

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities & stack ht increase #2
100% conversion
Max DV: 496 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

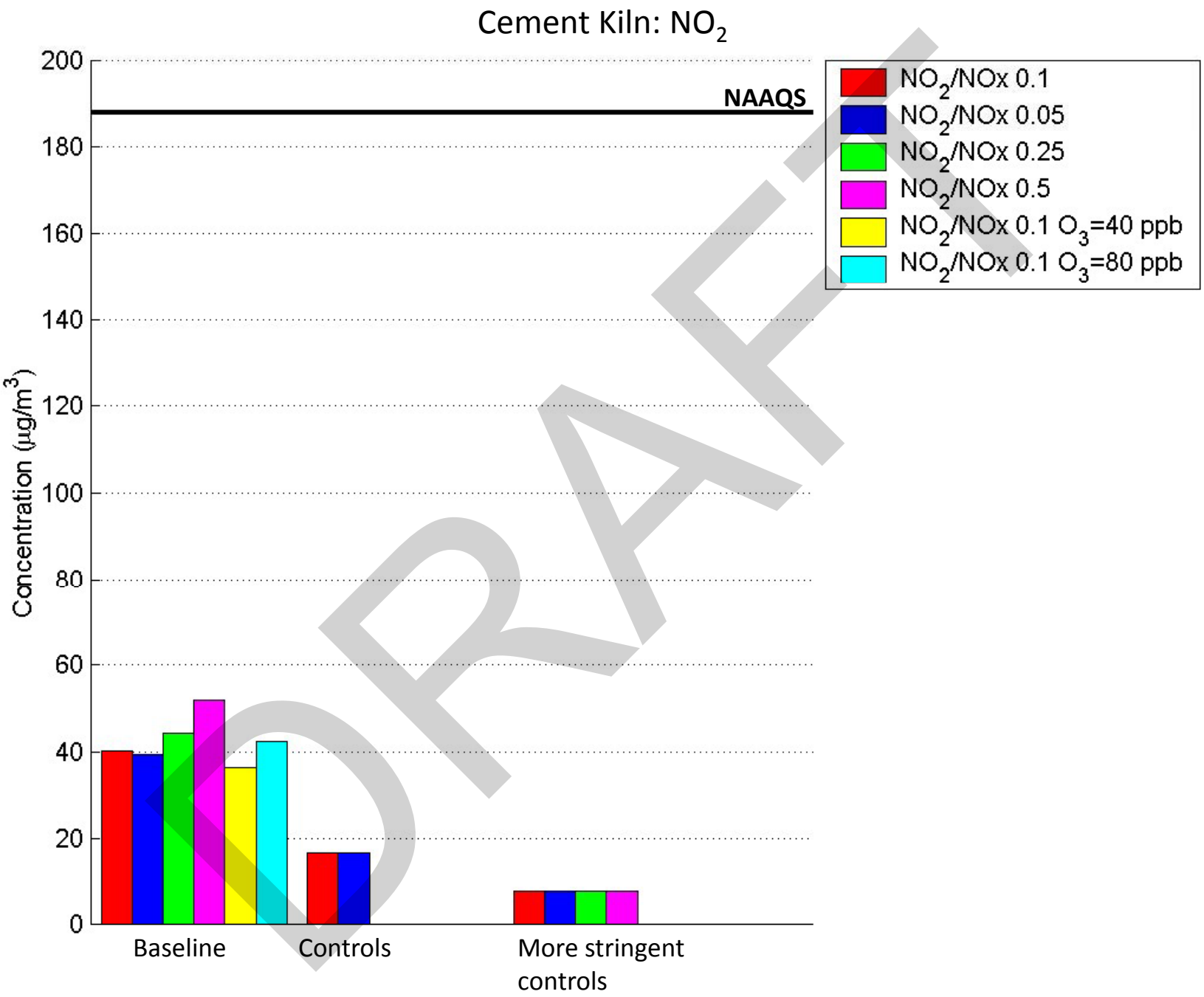

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities & stack ht increase #2
PVMRM
0.1 NO2/NOx in-stack ratio
Max DV: 162 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters

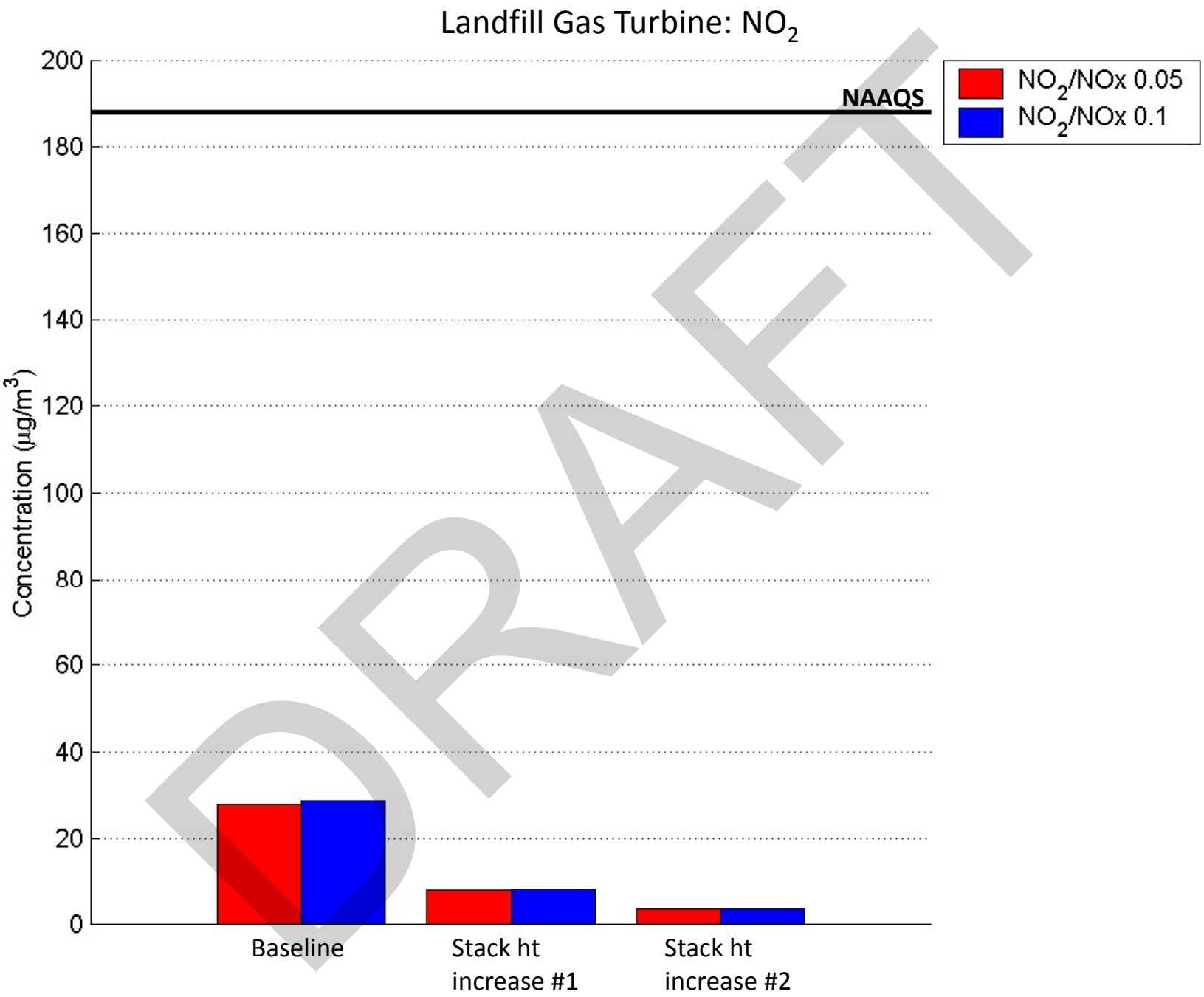

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities & stack ht increase #2
PVMRM
0.5 NO2/NOx in-stack ratio
Max DV: 1262 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT


Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities
100% conversion
Max DV: 13129 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters

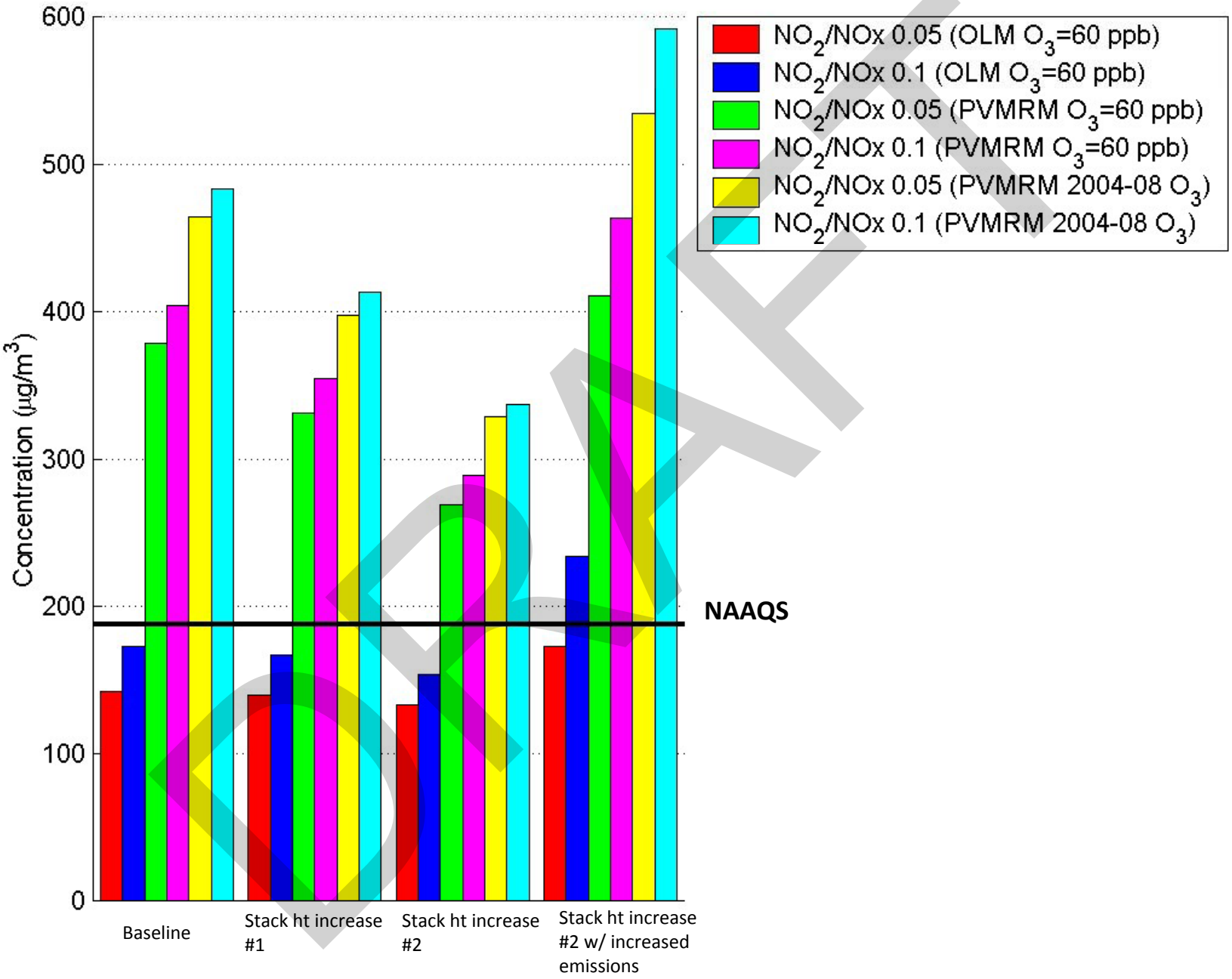

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities
80% ARM
Max DV: 10503 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

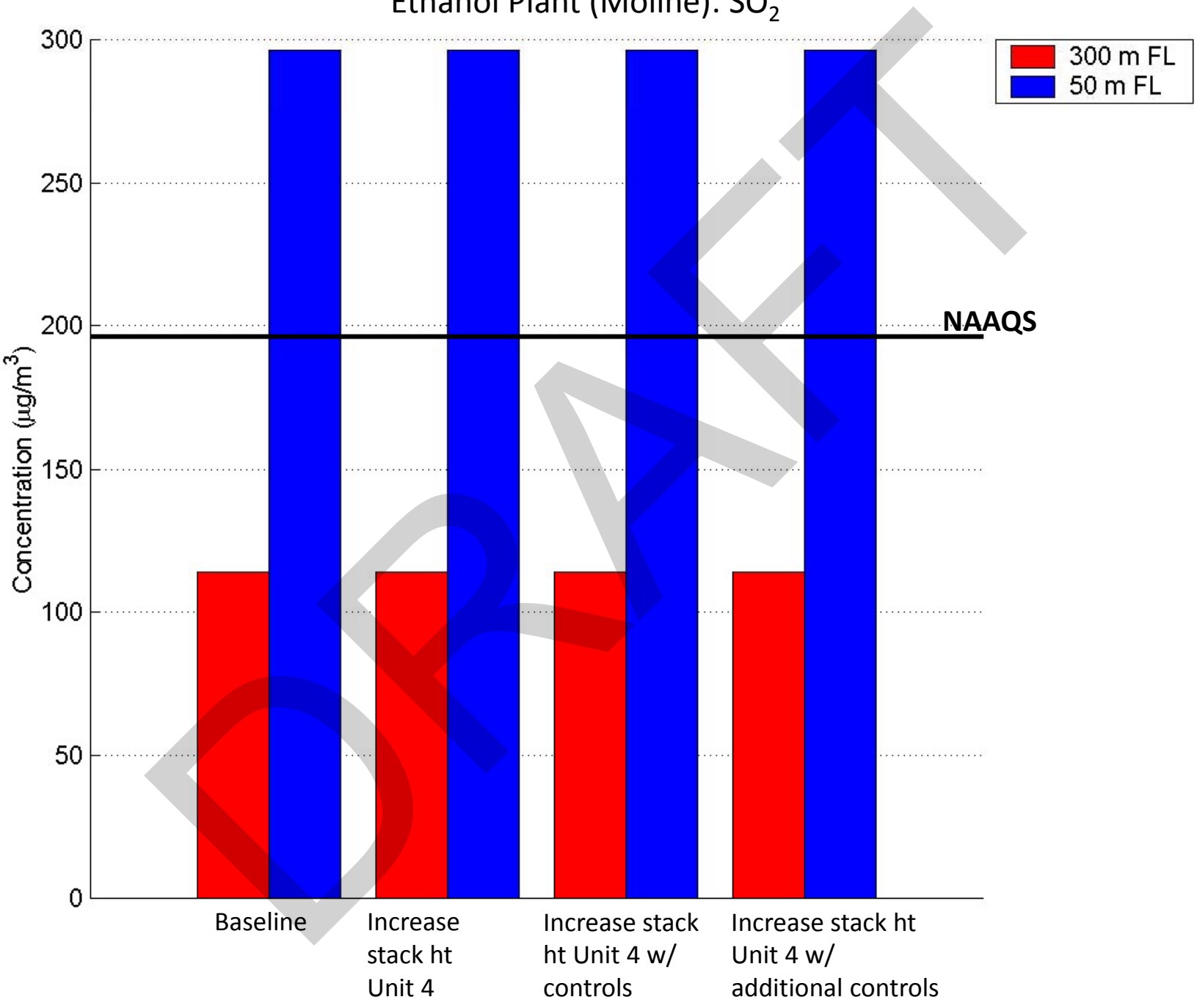

Legend
14 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 188
189 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
Less controls for 3 of 4 facilities
PVMRM
0.1 NO2/NOx in-stack ratio
Max DV: 1674 µg/m3
0
1,250
2,500
5,000
7,500
10,000
Meters
DRAFT

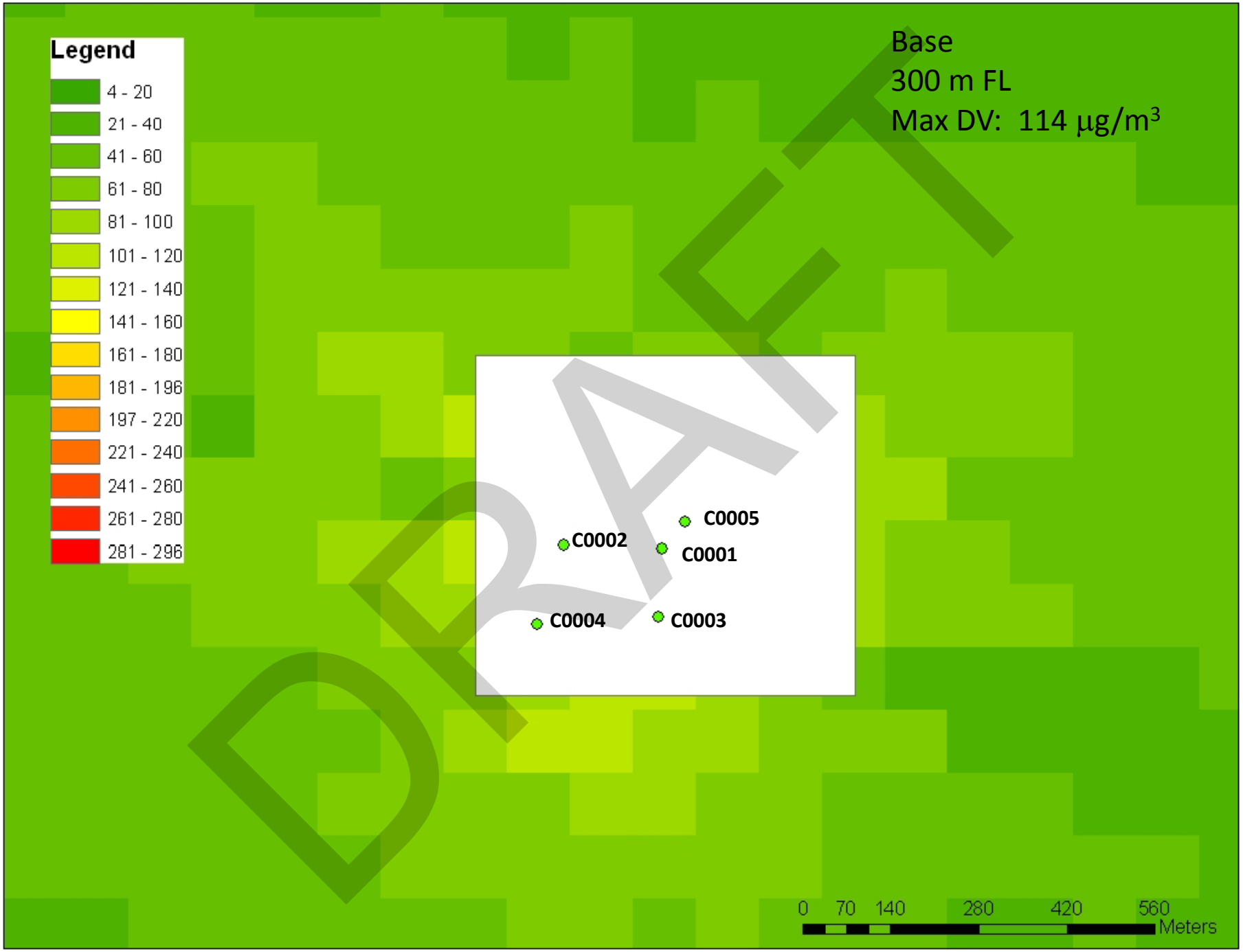

Cement Kiln: NO2
NAAQS
NO2/NOx 0.1
NO2/NOx 0.05
NO2/NOx 0.25
NO2/NOx 0.5
NO2/NOx 0.1 O3=40 ppb
NO2/NOx 0.1 O3=80 ppb
Concentration (µg/m3)
200
180
160
140
120
100
80
60
40
20
0
Baseline
Controls
More stringent controls

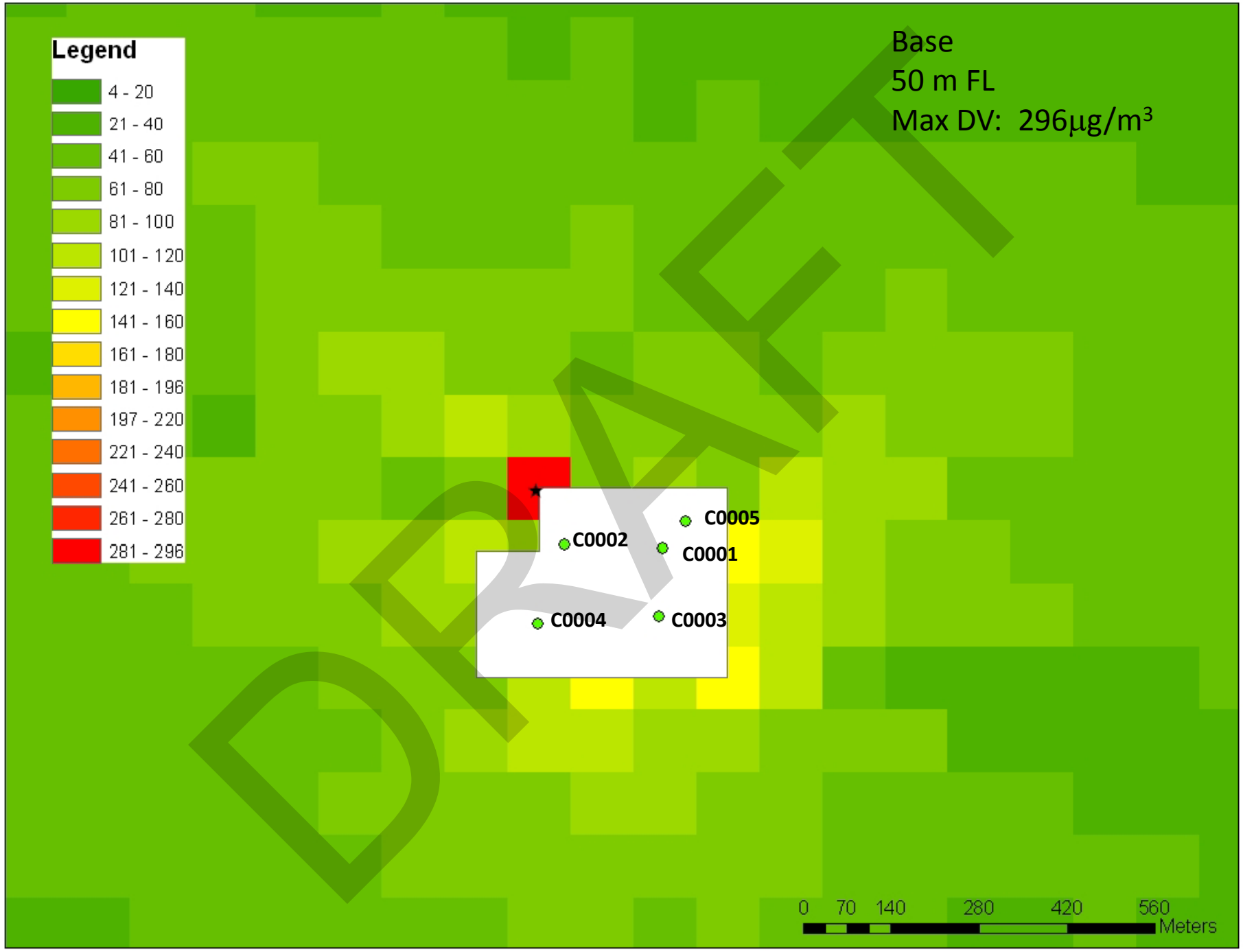

Landfill Gas Turbine: NO2
NAAQS
NO2/NOx 0.05
NO2/NOx 0.1
Concentration (µg/m3)
200
180
160
140
120
100
80
60
40
20
0
Baseline
Stack ht increase #1
Stack ht increase #2

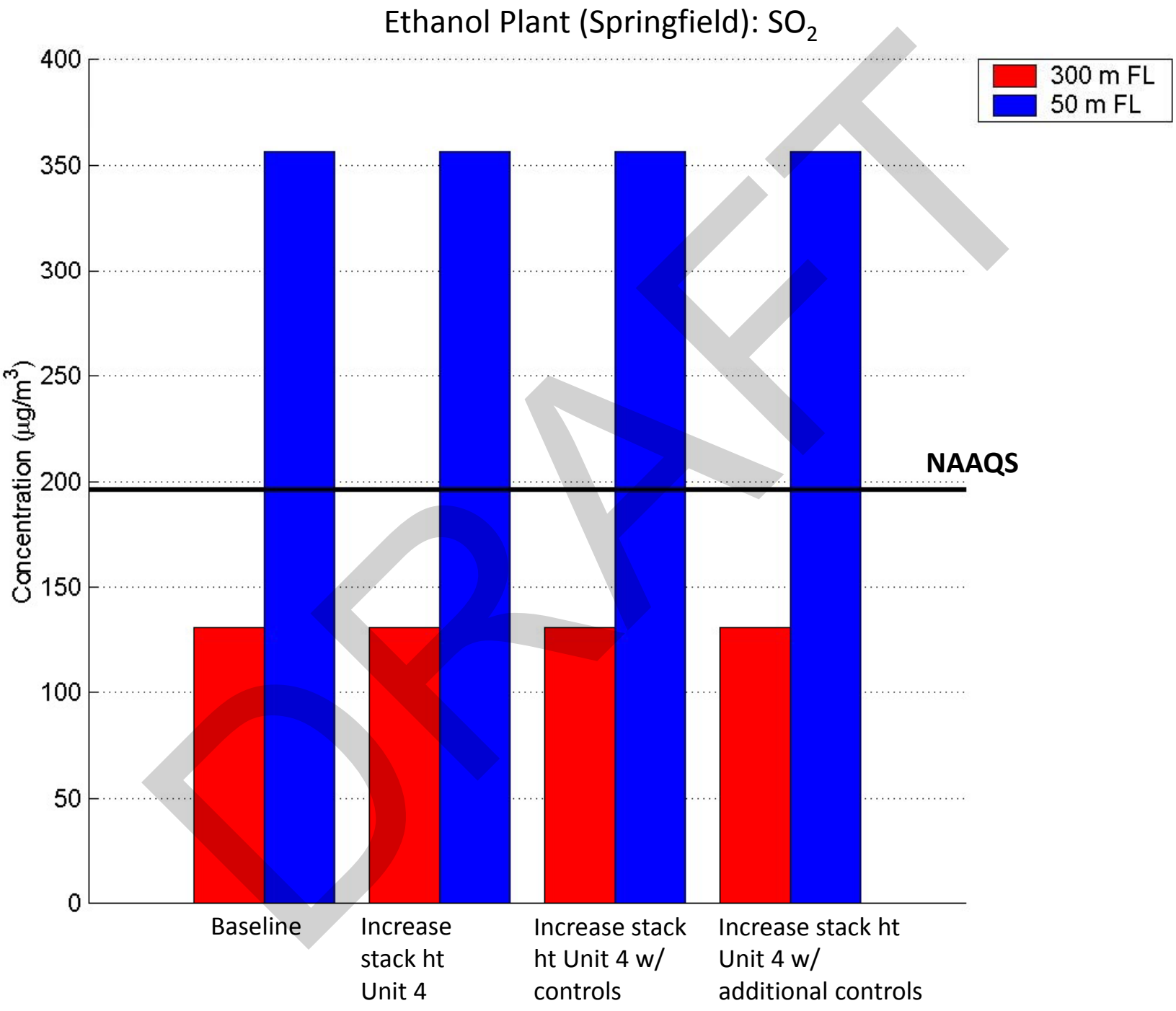
Fuel Oil Turbine: NO_2

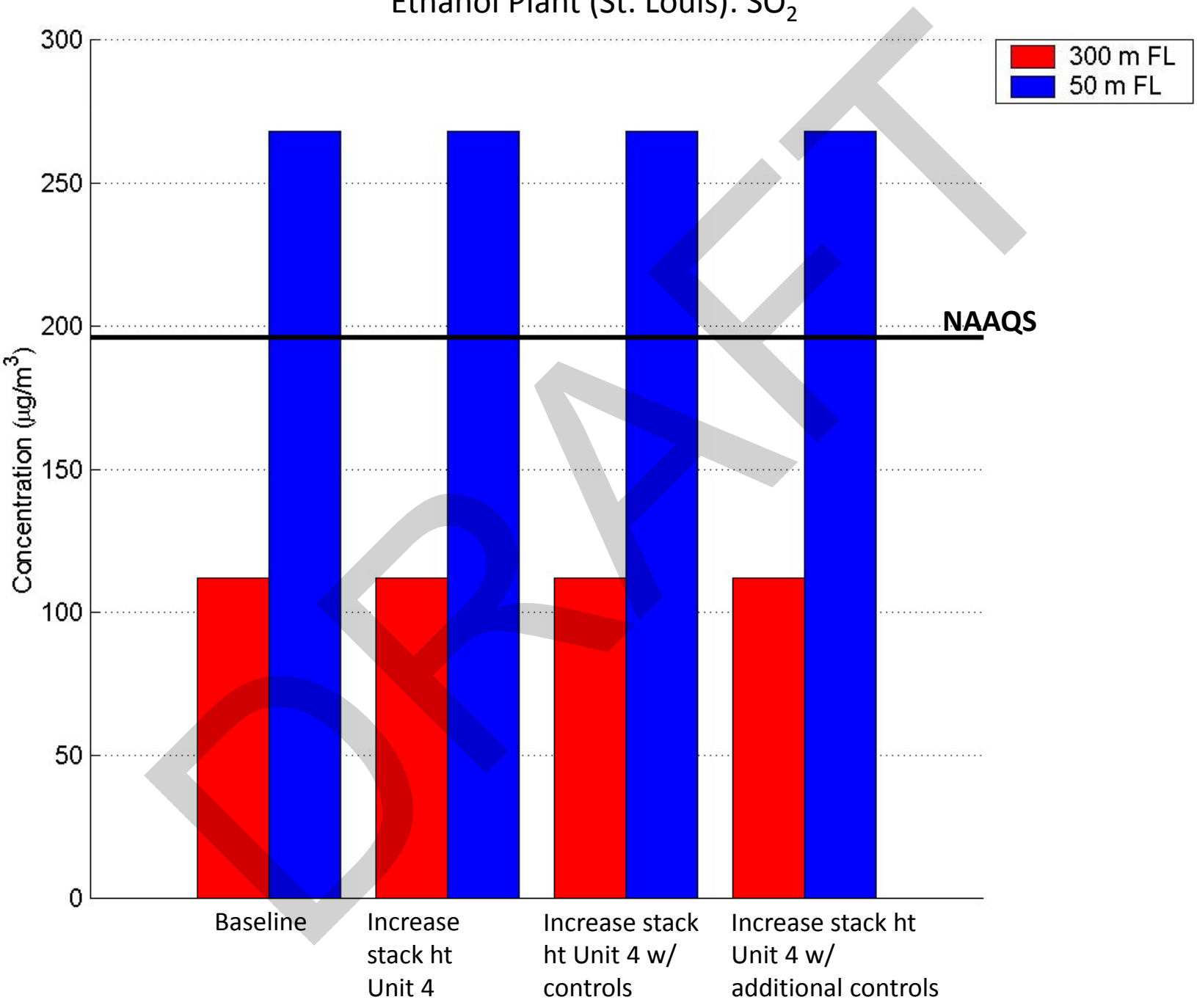


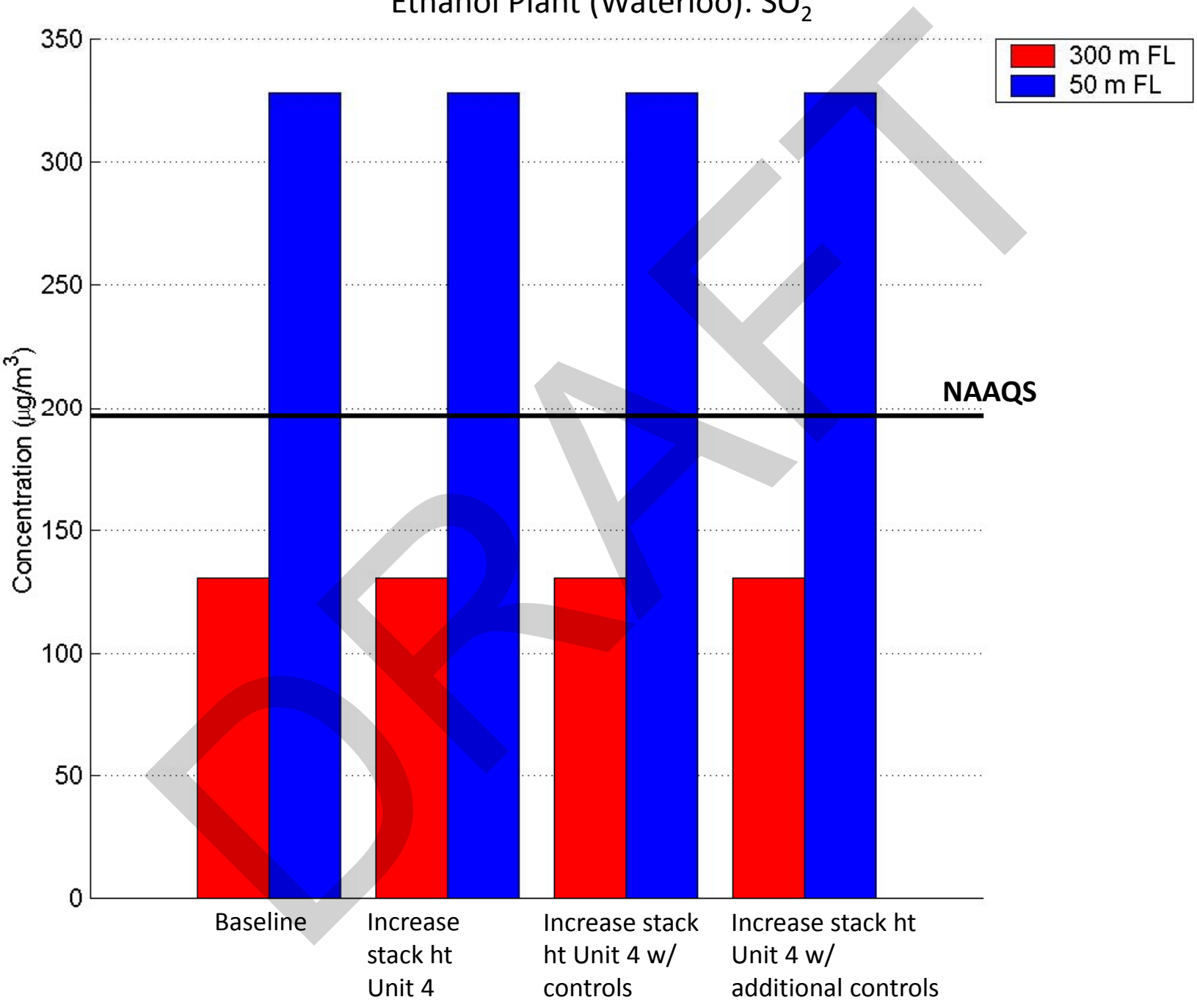

Ethanol Plant (Moline): SO_2
300 m FL
50 m FL
NAAQS
Concentration (µg/m^3)
300
250
200
150
100
50
0
Baseline
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls

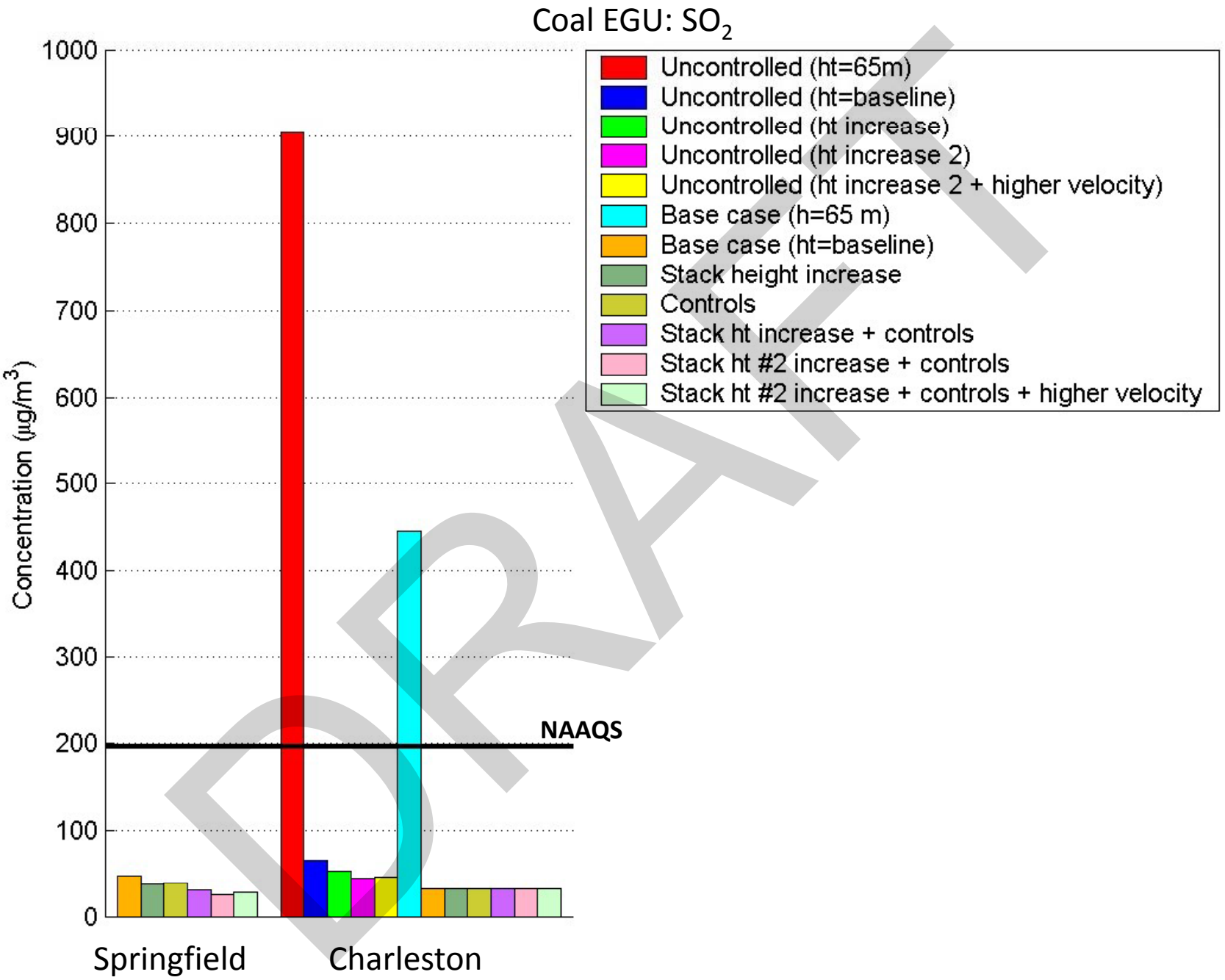

Legend
4 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 120
121 - 140
141 - 160
161 - 180
181 - 196
197 - 220
221 - 240
241 - 260
261 - 280
281 - 296
Base
300 m FL
Max DV: 114 µg/m3
C0005
C0002
C0001
C0004
C0003
0 70 140 280 420 560
Meters
DRAFT

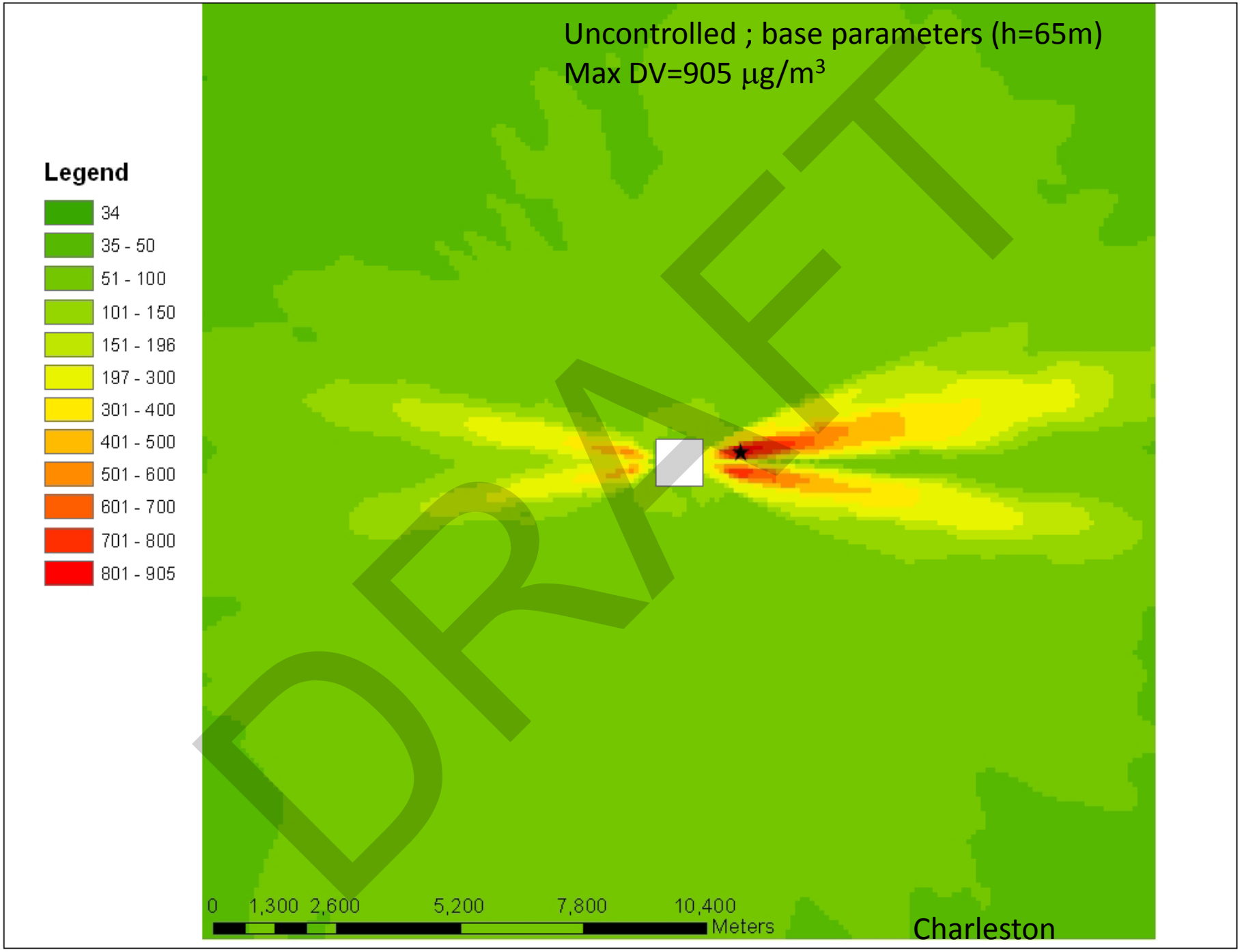

Legend
4 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 120
121 - 140
141 - 160
161 - 180
181 - 196
197 - 220
221 - 240
241 - 260
261 - 280
281 - 296
Base
50 m FL
Max DV: 296µg/m3
C0005
C0002
C0001
C0004
C0003
0 70 140 280 420 560
Meters
DRAFT

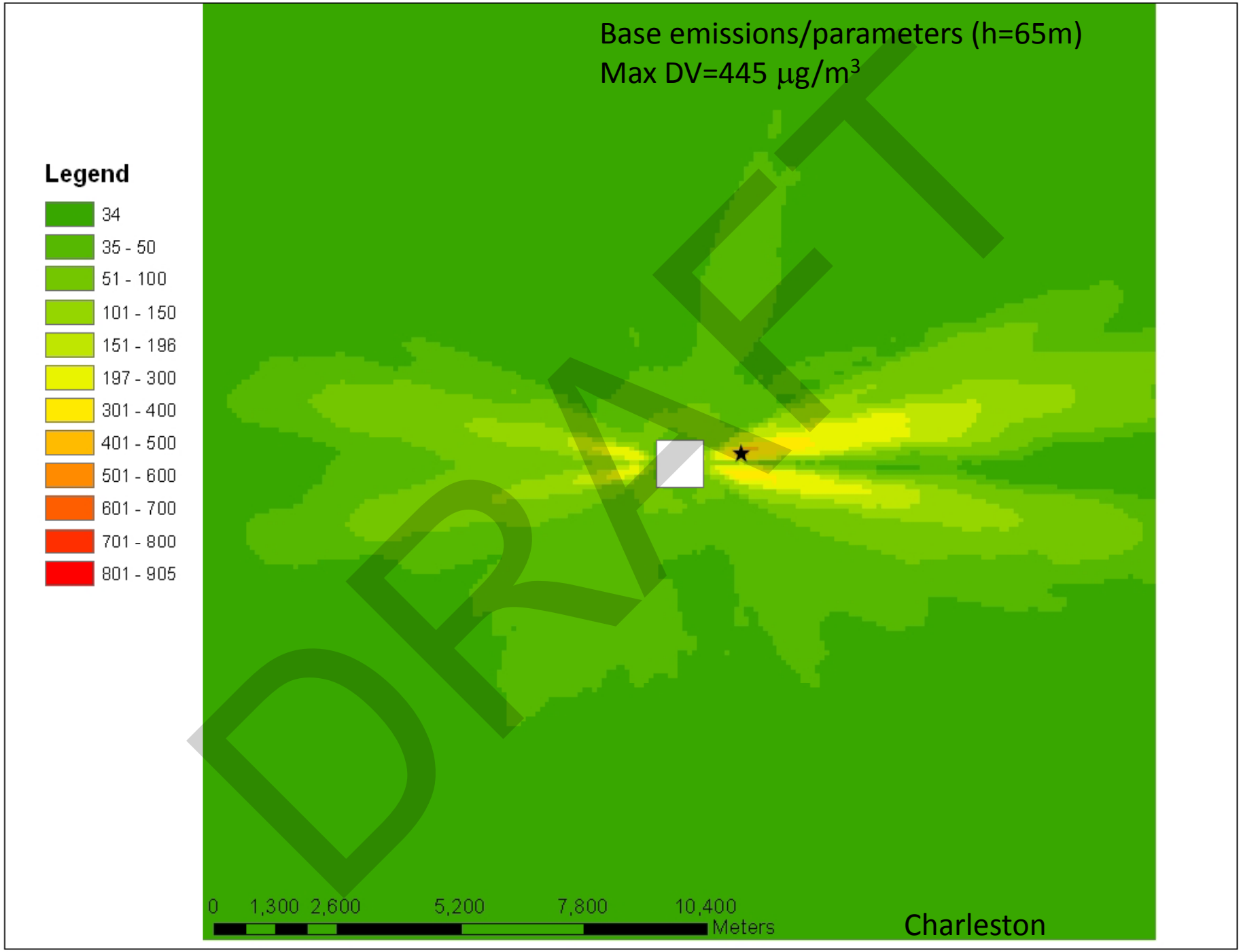

Ethanol Plant (Springfield): SO2
300 m FL
50 m FL
NAAQS
Concentration (µg/m3)
400
350
300
250
200
150
100
50
0
Baseline
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls
DRAFT

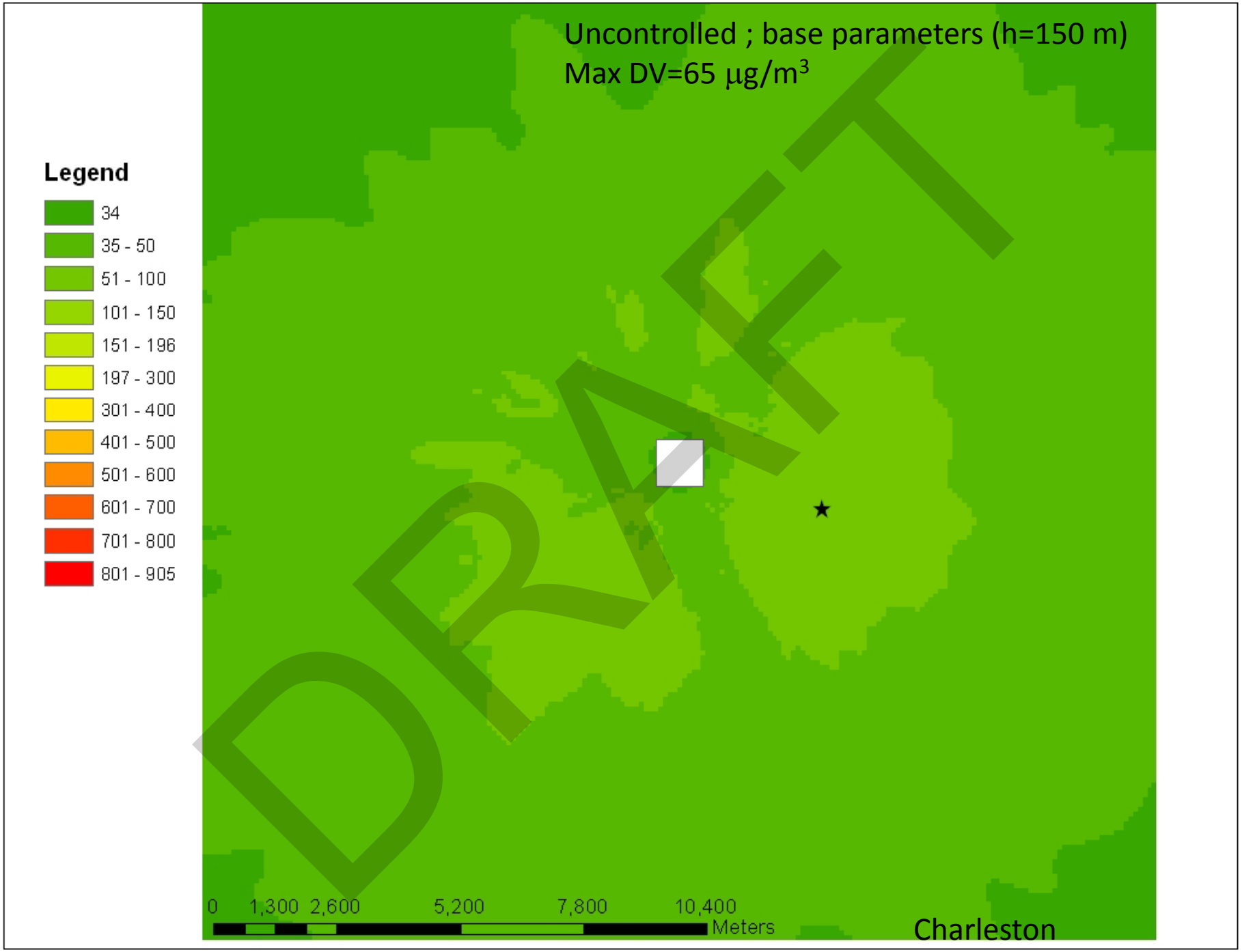

Ethanol Plant (St. Louis): SO2
300 m FL
50 m FL
NAAQS
Concentration (µg/m3)
300
250
200
150
100
50
0
Baseline
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls

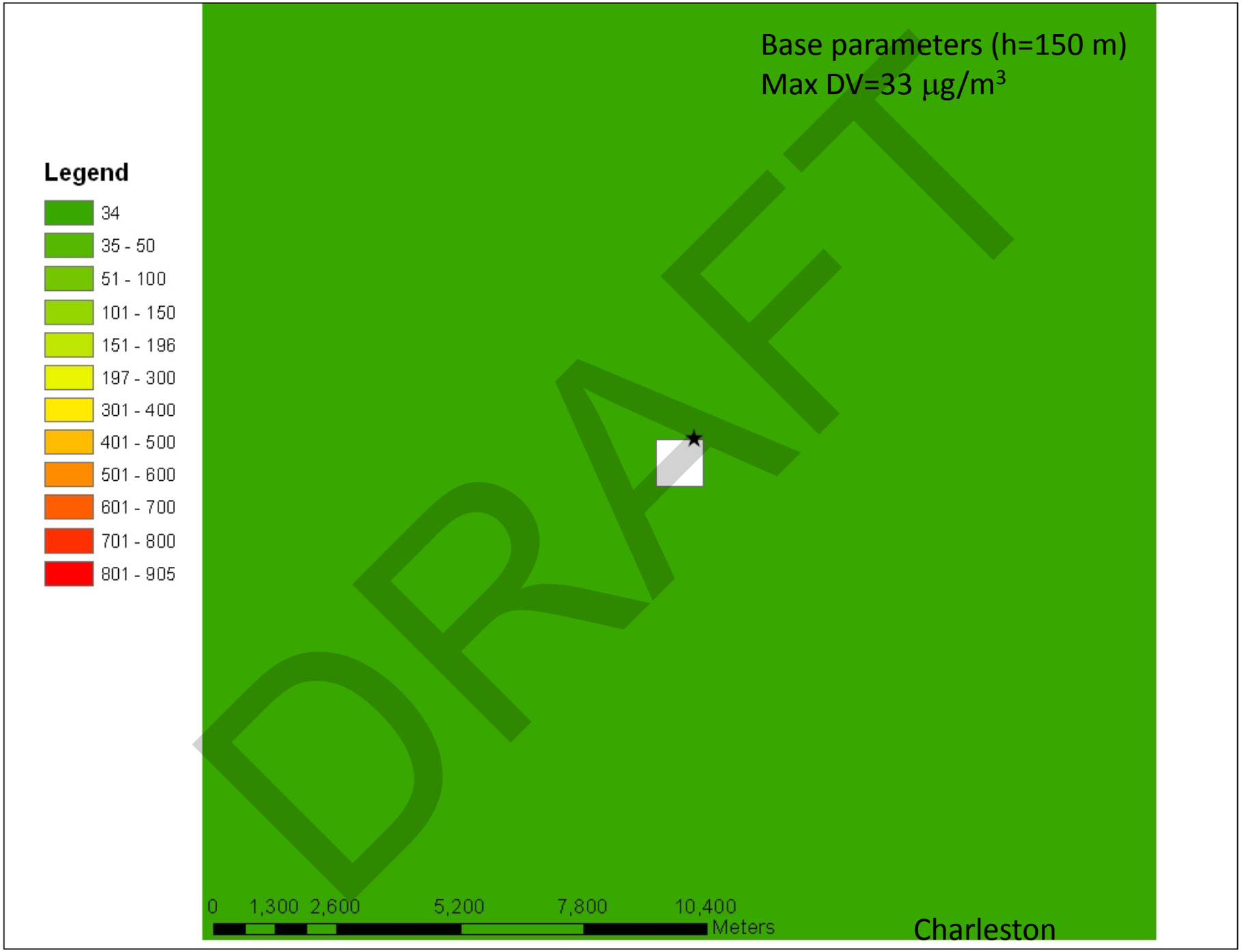

Ethanol Plant (Waterloo): SO2
300 m FL
50 m FL
NAAQS
Concentration (µg/m3)
350
300
250
200
150
100
50
0
Baseline
Increase stack ht Unit 4
Increase stack ht Unit 4 w/ controls
Increase stack ht Unit 4 w/ additional controls
DRAFT

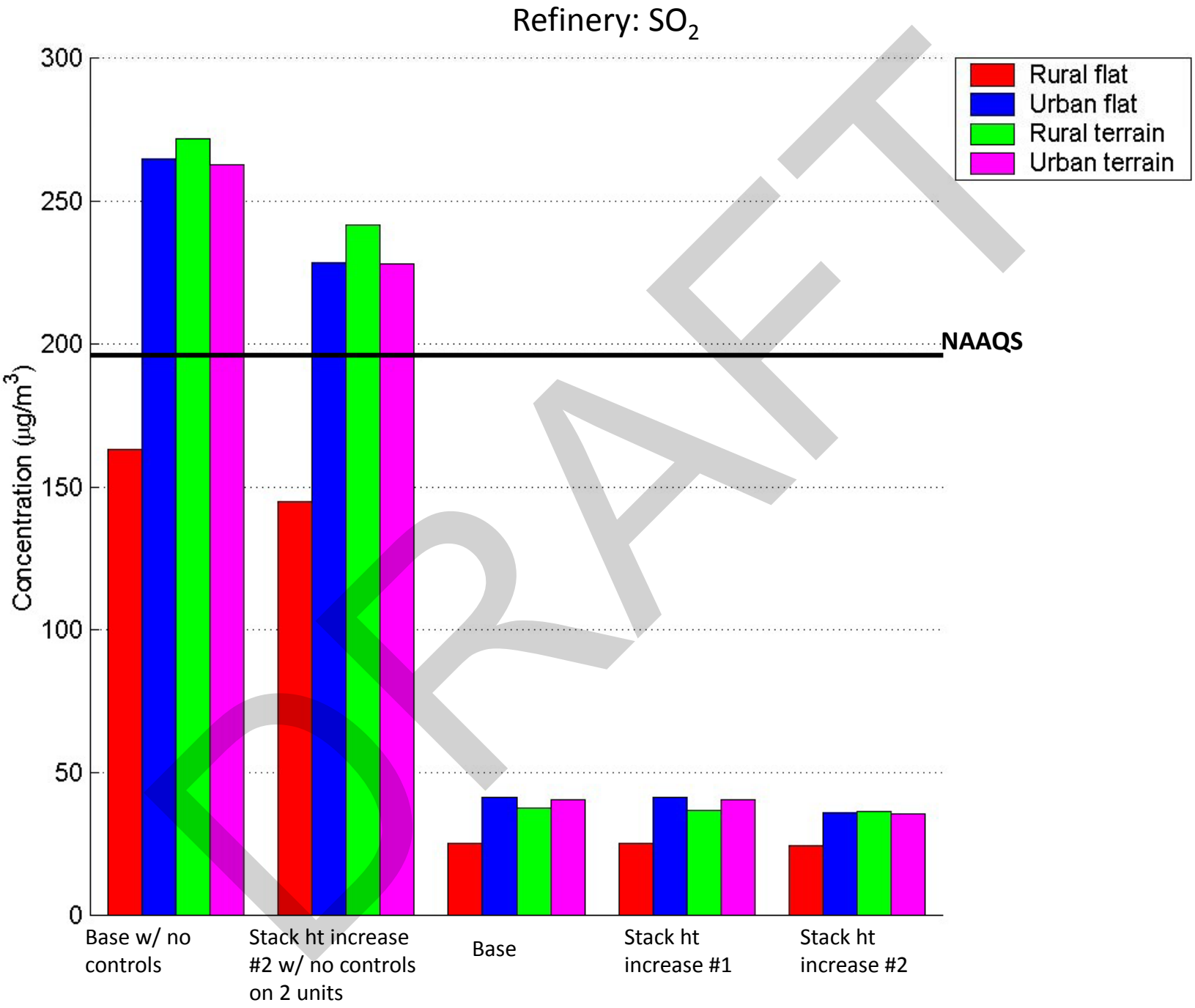

Coal EGU: SO_2
Concentration ($\mu g/m^3$)
1000
900
800
700
600
500
400
300
200
100
0
NAAQS
Springfield
Charleston
Uncontrolled (ht=65m)
Uncontrolled (ht=baseline)
Uncontrolled (ht increase)
Uncontrolled (ht increase 2)
Uncontrolled (ht increase 2 + higher velocity)
Base case (h=65 m)
Base case (ht=baseline)
Stack height increase
Controls
Stack ht increase + controls
Stack ht #2 increase + controls
Stack ht #2 increase + controls + higher velocity

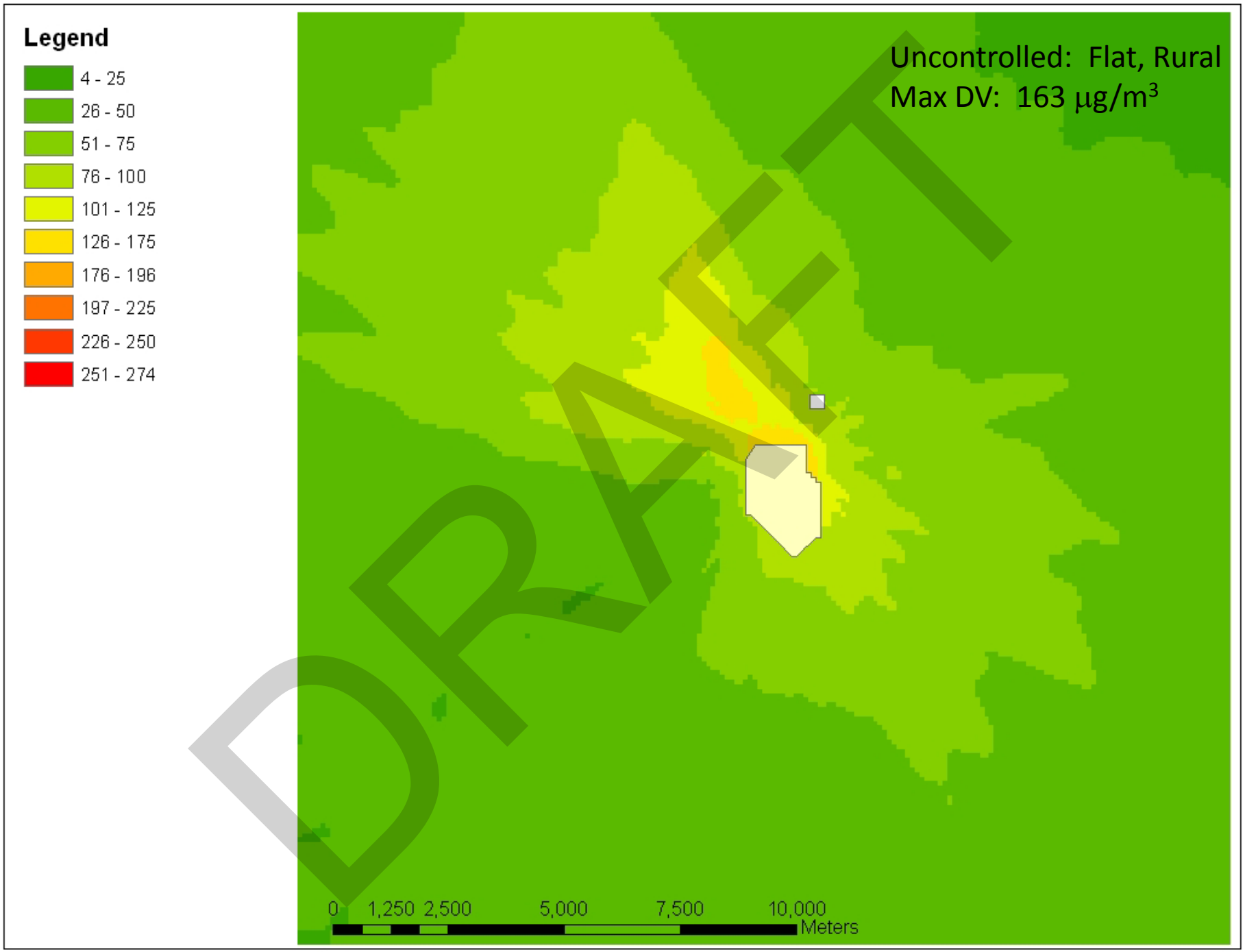

Uncontrolled ; base parameters (h=65m)
Max DV=905 µg/m3
Legend
34
35 - 50
51 - 100
101 - 150
151 - 196
197 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 905
0 1,300 2,600 5,200 7,800 10,400
Meters
Charleston
DRAFT

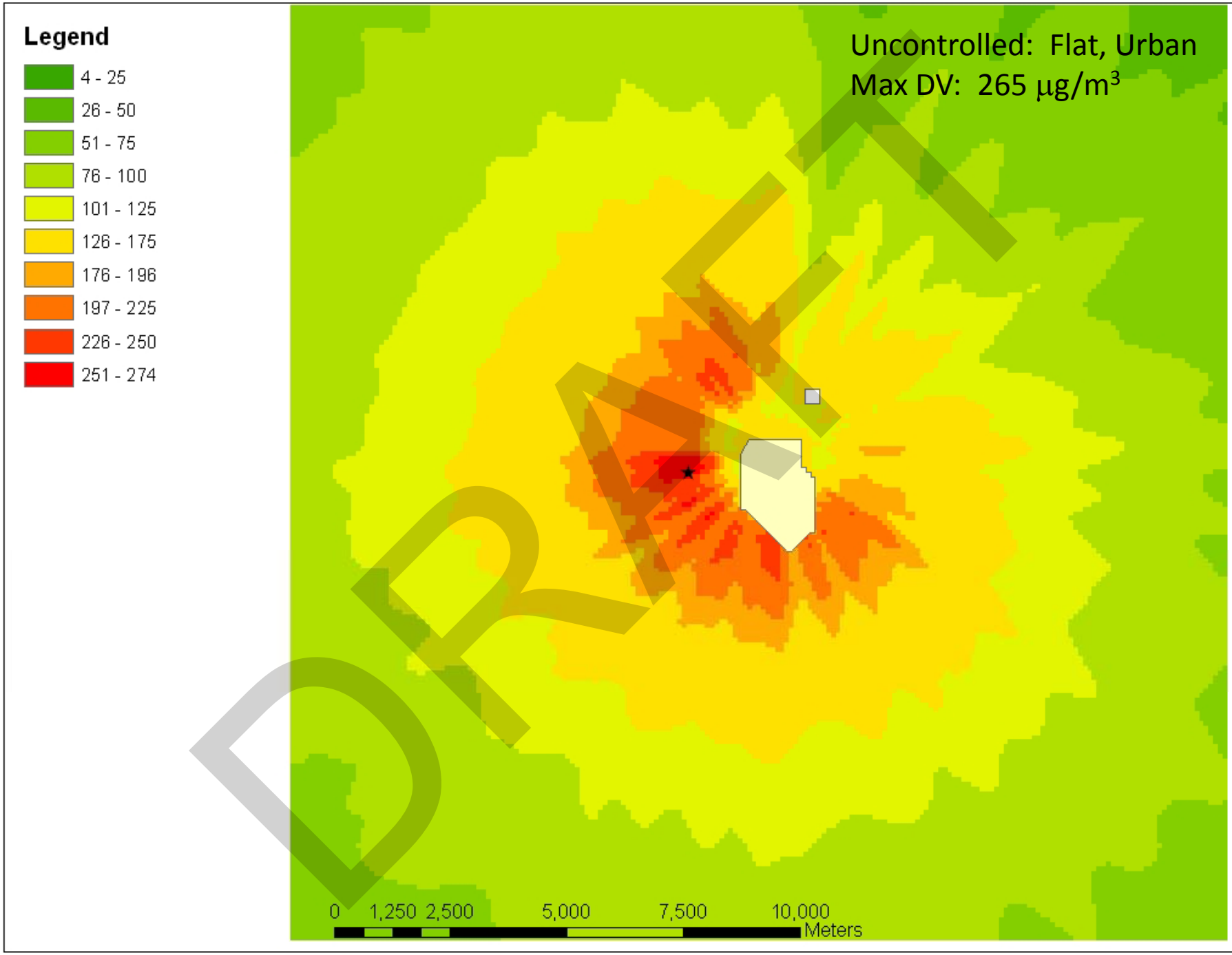

Base emissions/parameters (h=65m)
Max DV=445 µg/m3
Legend
34
35 - 50
51 - 100
101 - 150
151 - 196
197 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 905
0 1,300 2,600 5,200 7,800 10,400
Meters
Charleston
DRAFT

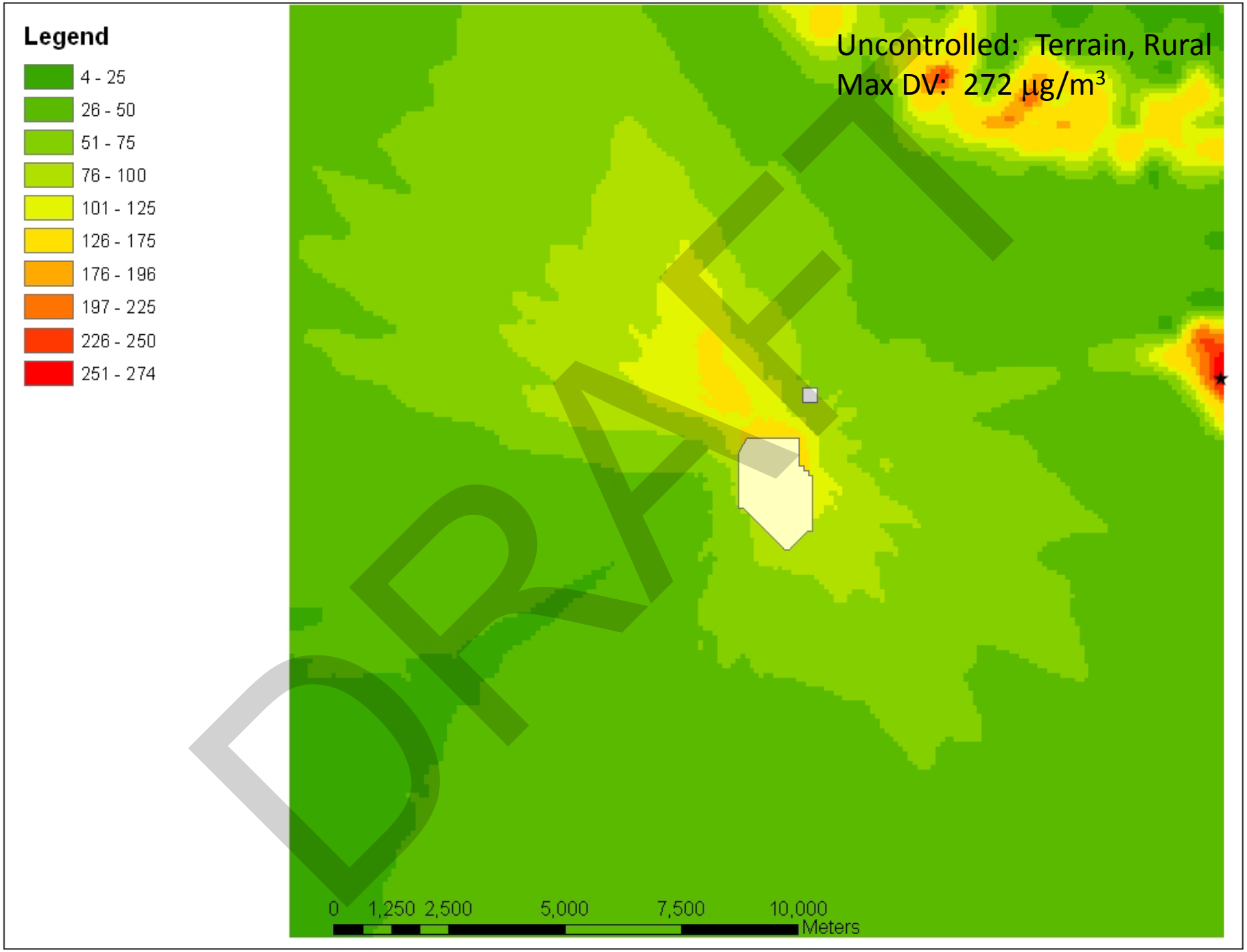

Uncontrolled ; base parameters (h=150 m)
Max DV=65 µg/m3
Legend
34
35 - 50
51 - 100
101 - 150
151 - 196
197 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 905
0 1,300 2,600 5,200 7,800 10,400
Meters
Charleston
DRAFT

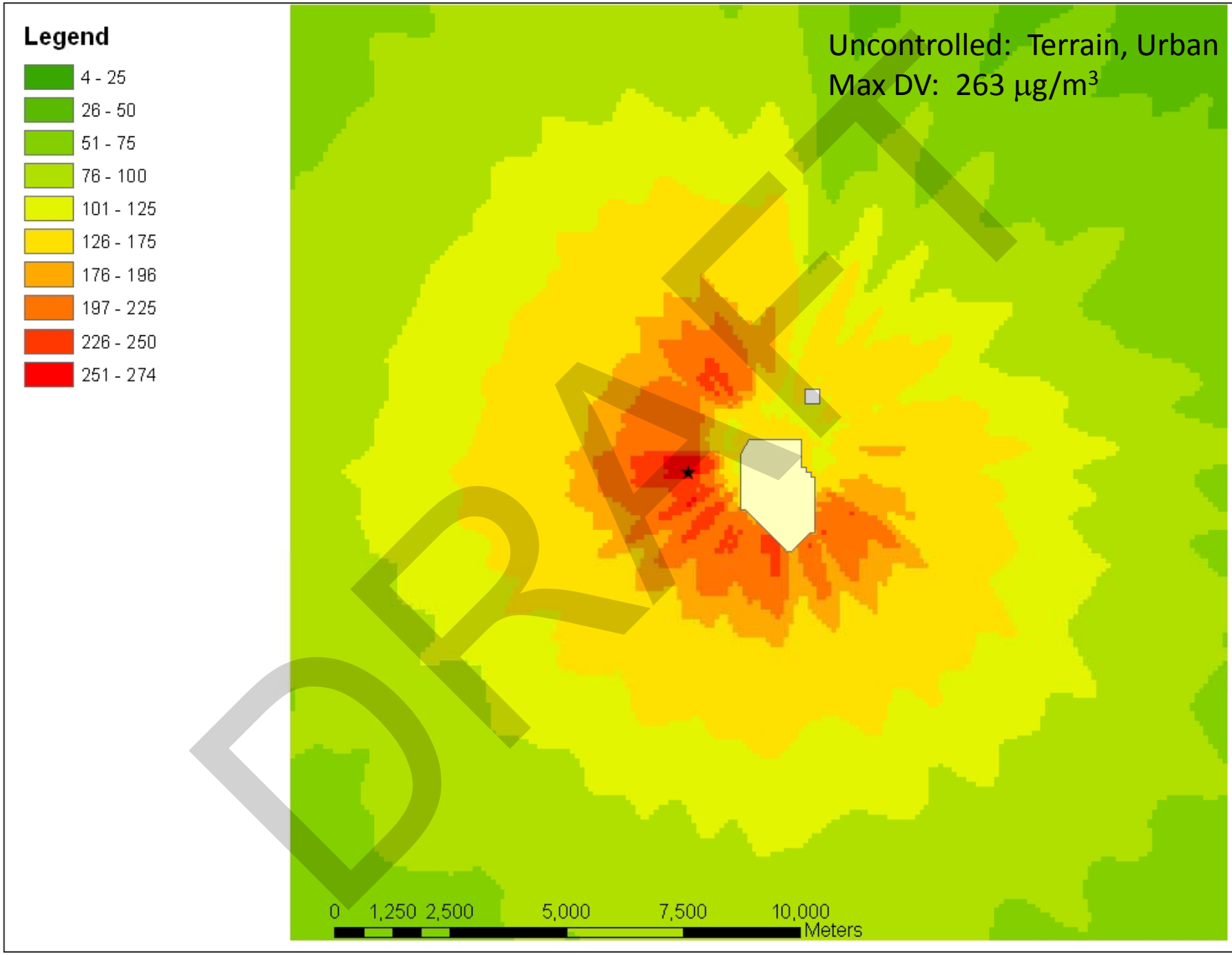

Base parameters (h=150 m)
Max DV=33 µg/m3
Legend
34
35 - 50
51 - 100
101 - 150
151 - 196
197 - 300
301 - 400
401 - 500
501 - 600
601 - 700
701 - 800
801 - 905
0 1,300 2,600 5,200 7,800 10,400
Meters
Charleston
DRAFT

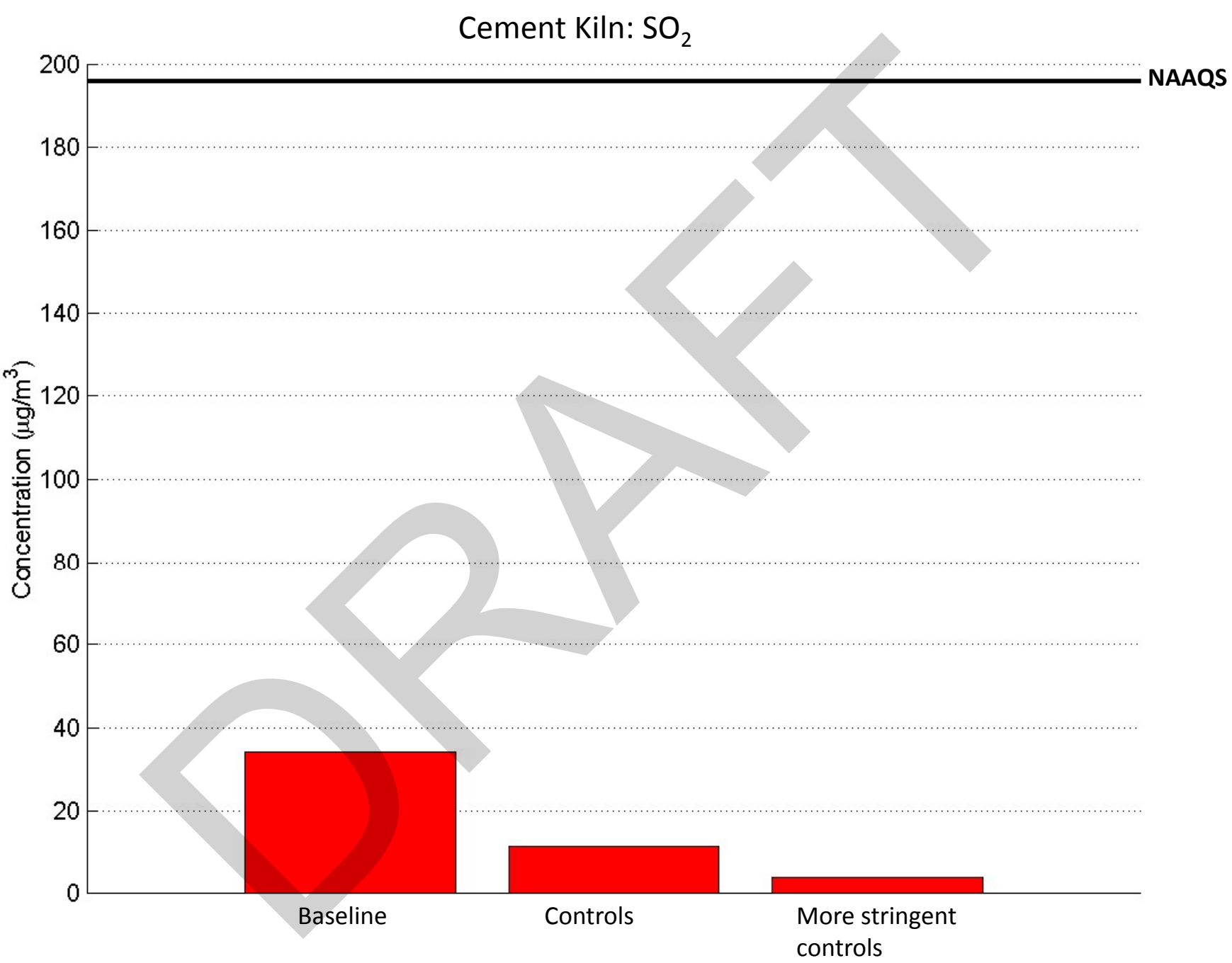

Refinery: SO_2
Rural flat
Urban flat
Rural terrain
Urban terrain
NAAQS
Concentration (µg/m^3)
300
250
200
150
100
50
0
Base w/ no controls
Stack ht increase #2 w/ no controls on 2 units
Base
Stack ht increase #1
Stack ht increase #2

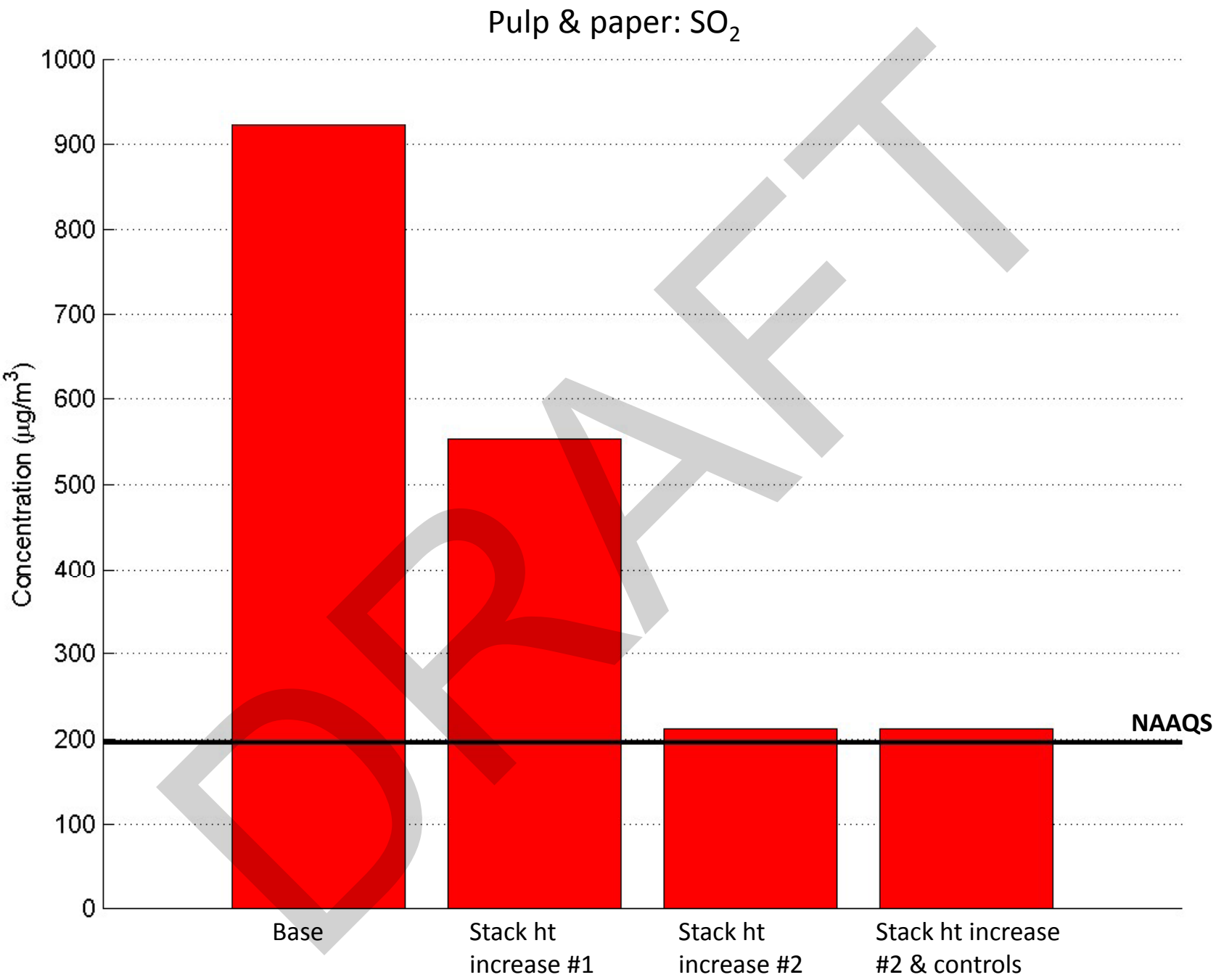

Legend
4 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 175
176 - 196
197 - 225
226 - 250
251 - 274
Uncontrolled: Flat, Rural
Max DV: 163 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

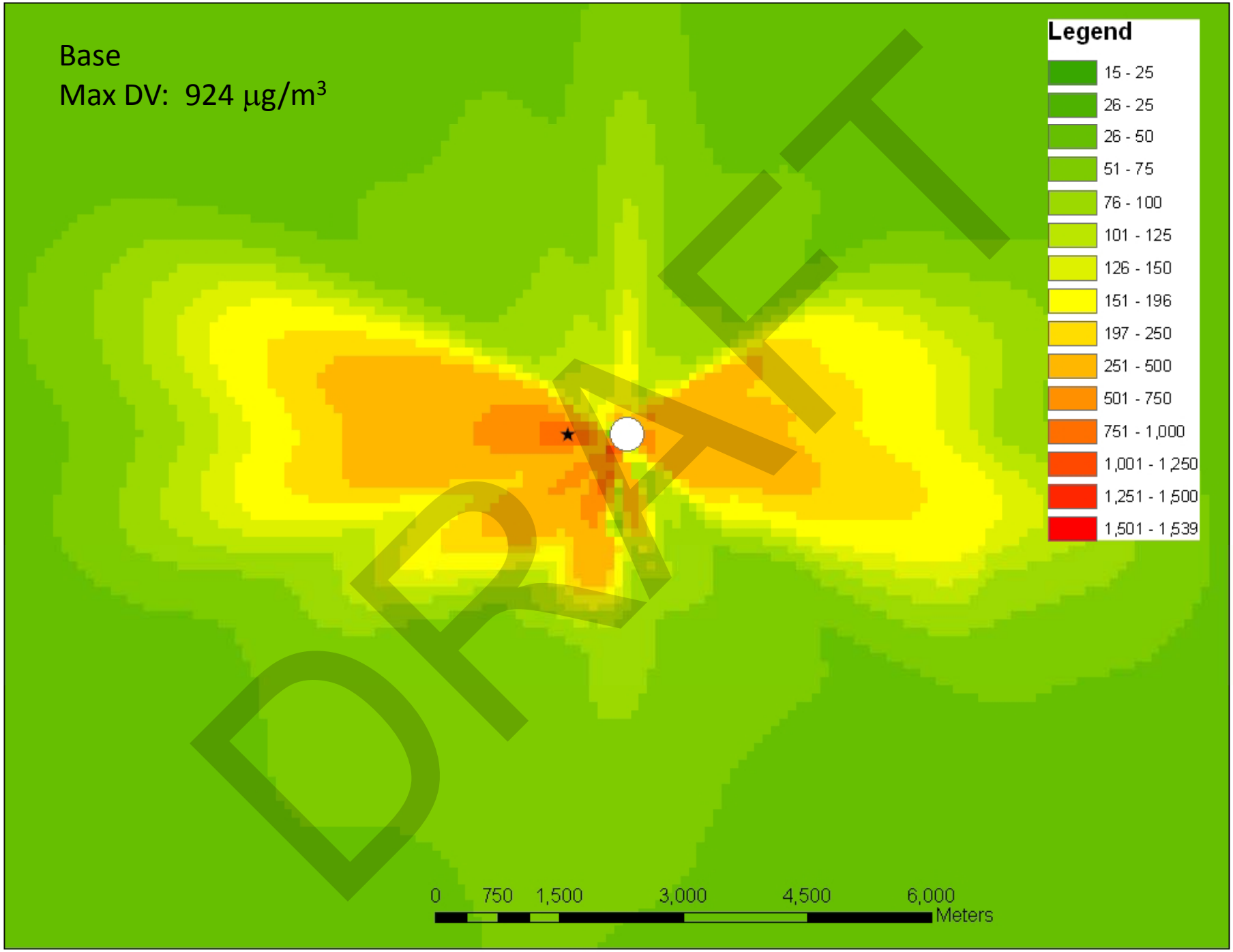

Legend
4 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 175
176 - 196
197 - 225
226 - 250
251 - 274
Uncontrolled: Flat, Urban
Max DV: 265 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

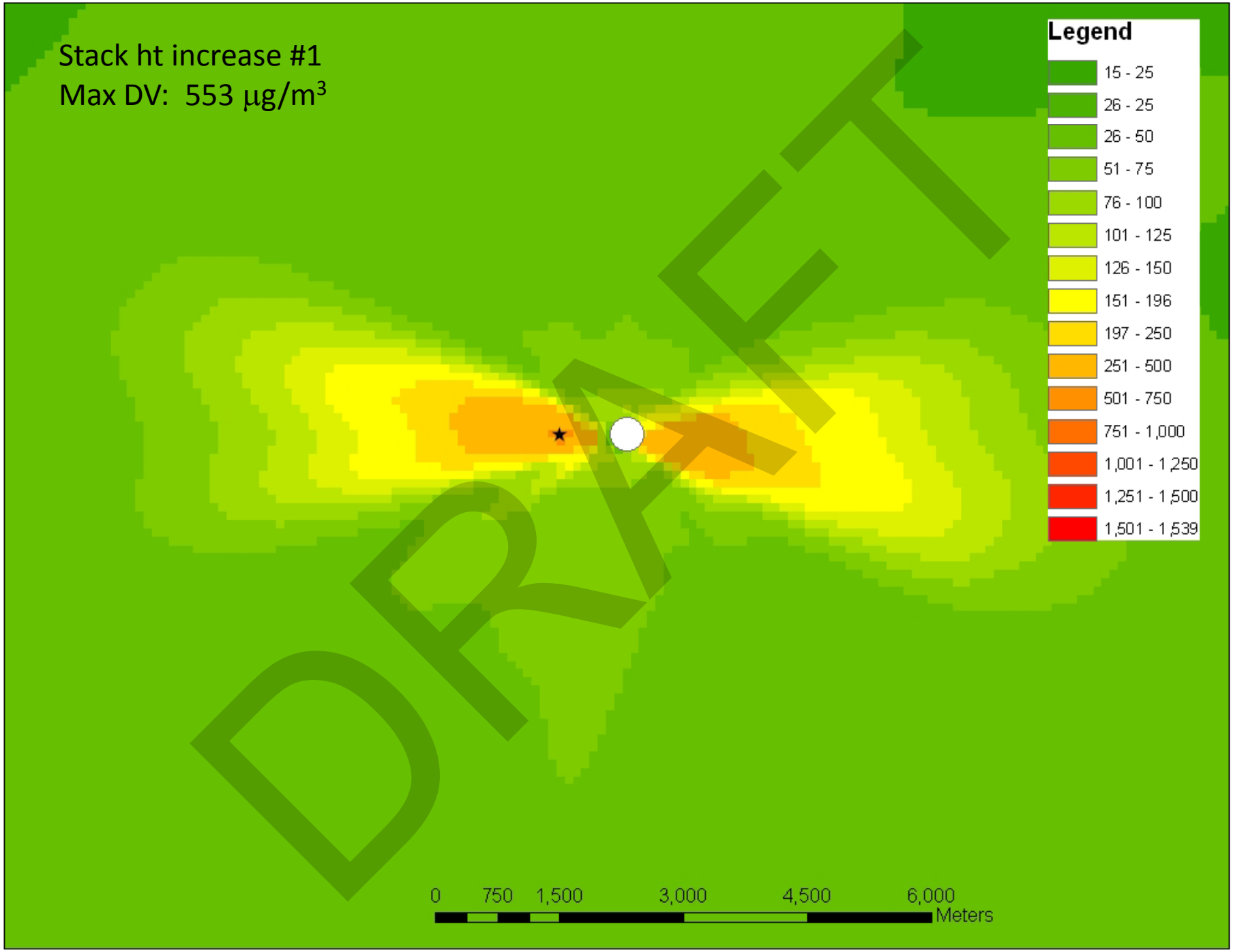

Legend
4 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 175
176 - 196
197 - 225
226 - 250
251 - 274
Uncontrolled: Terrain, Rural
Max DV: 272 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters
DRAFT

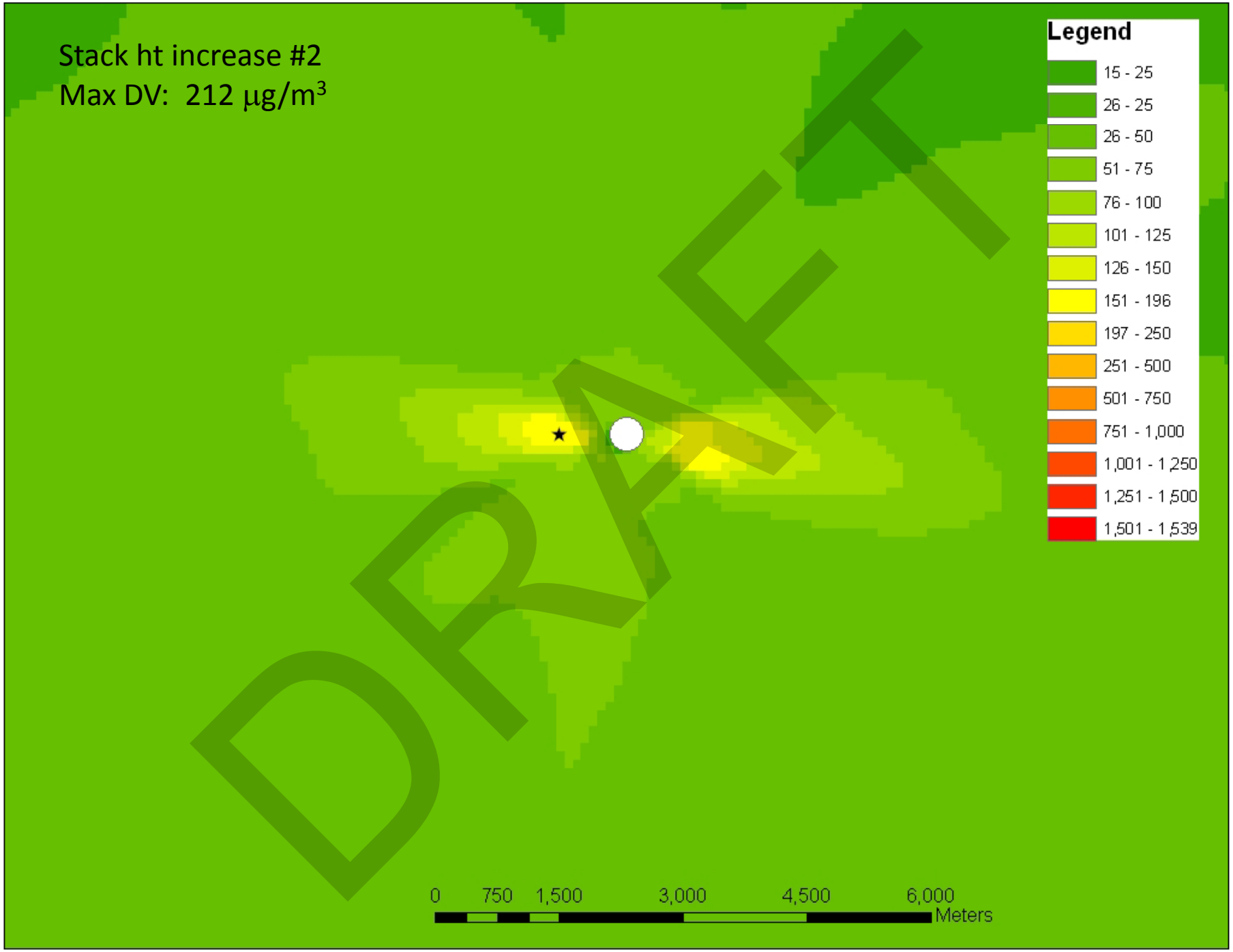

Legend
4 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 175
176 - 196
197 - 225
226 - 250
251 - 274
Uncontrolled: Terrain, Urban
Max DV: 263 µg/m³
0 1,250 2,500 5,000 7,500 10,000
Meters

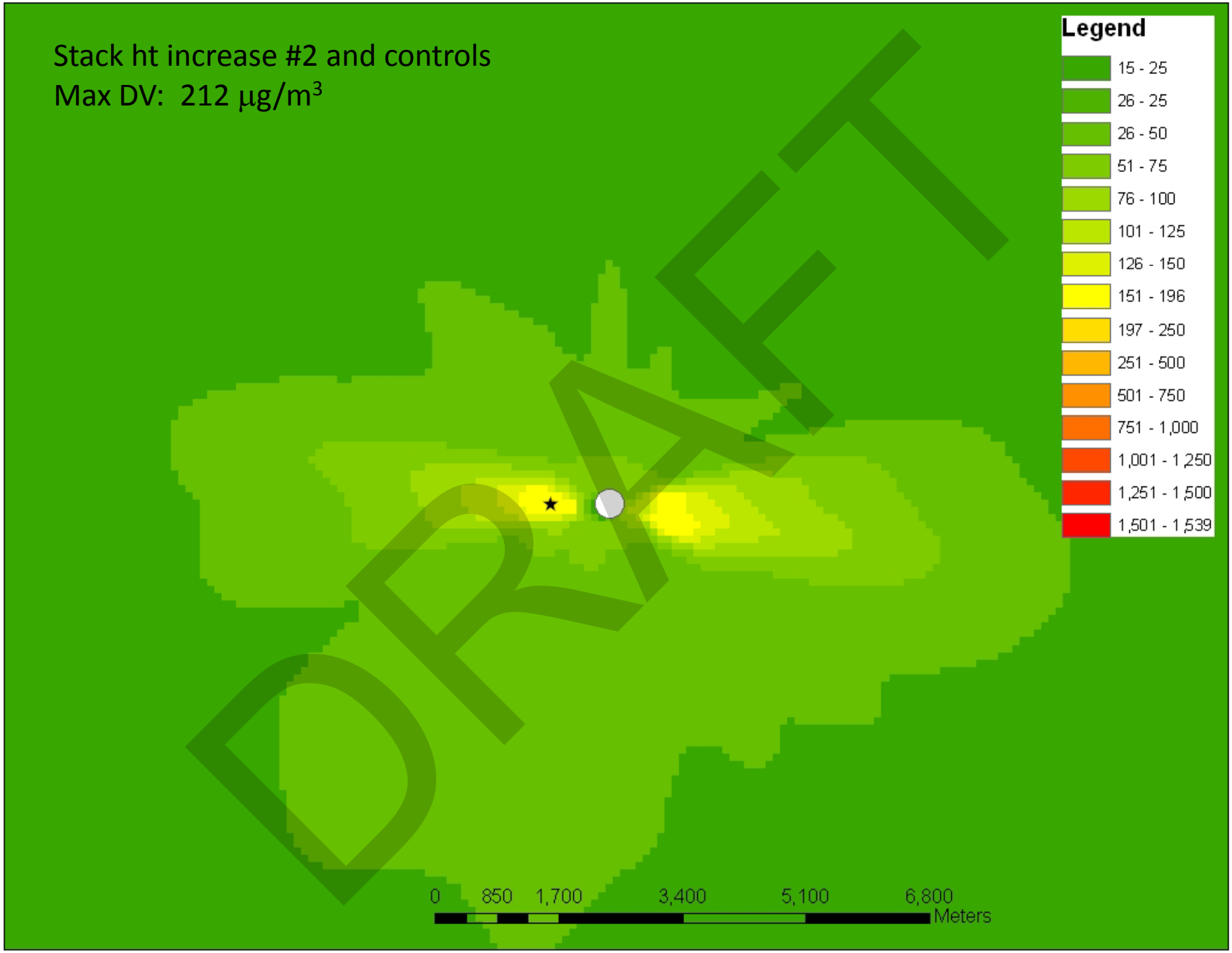

Cement Kiln: SO_2
200
180
160
140
120
100
80
60
40
20
0
Concentration (µg/m^3)
NAAQS
Baseline
Controls
More stringent controls

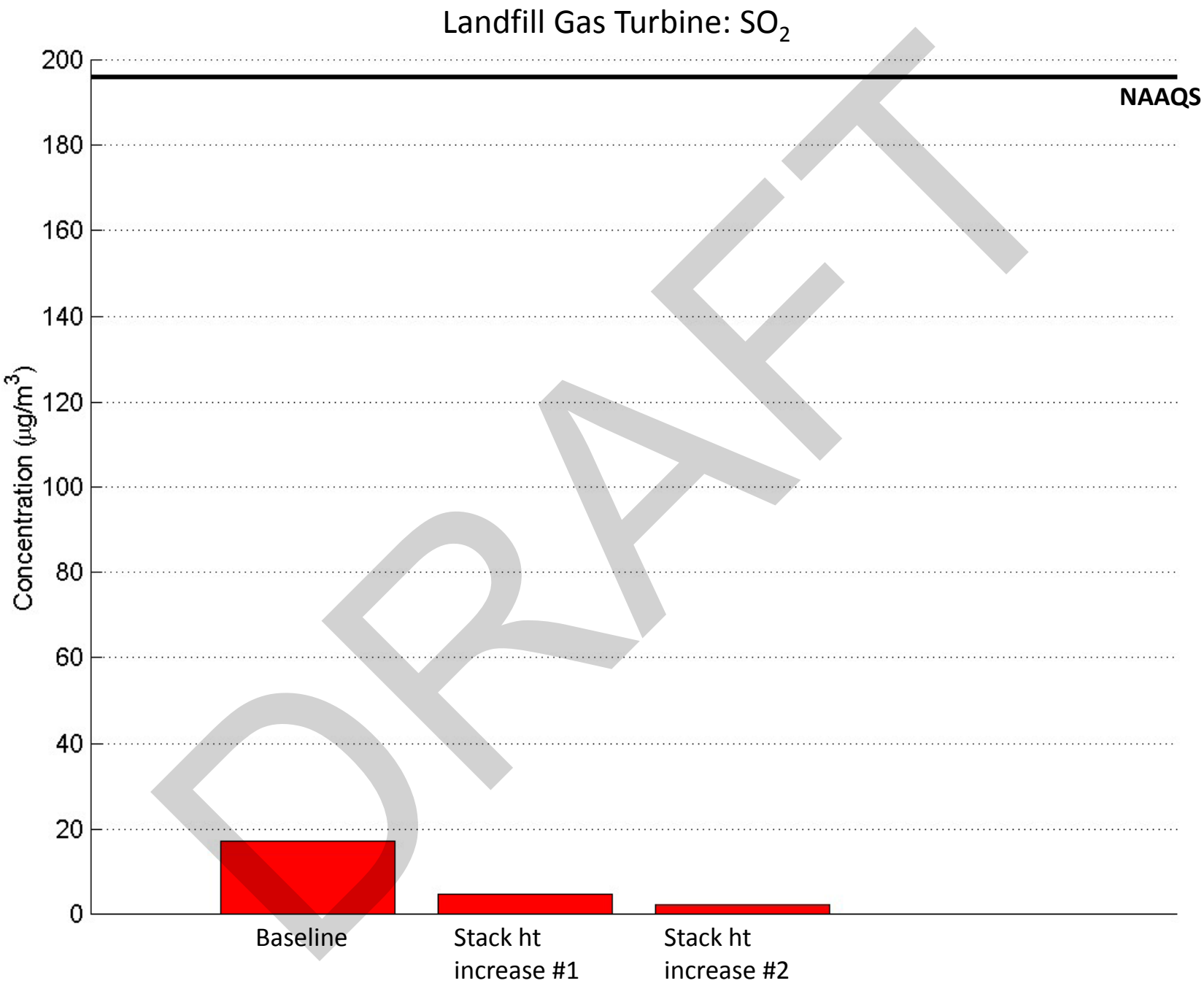

Pulp & paper: SO_2
1000
900
800
700
600
500
400
300
200
100
0
Concentration (µg/m^3)
NAAQS
Base
Stack ht increase #1
Stack ht increase #2
Stack ht increase #2 & controls

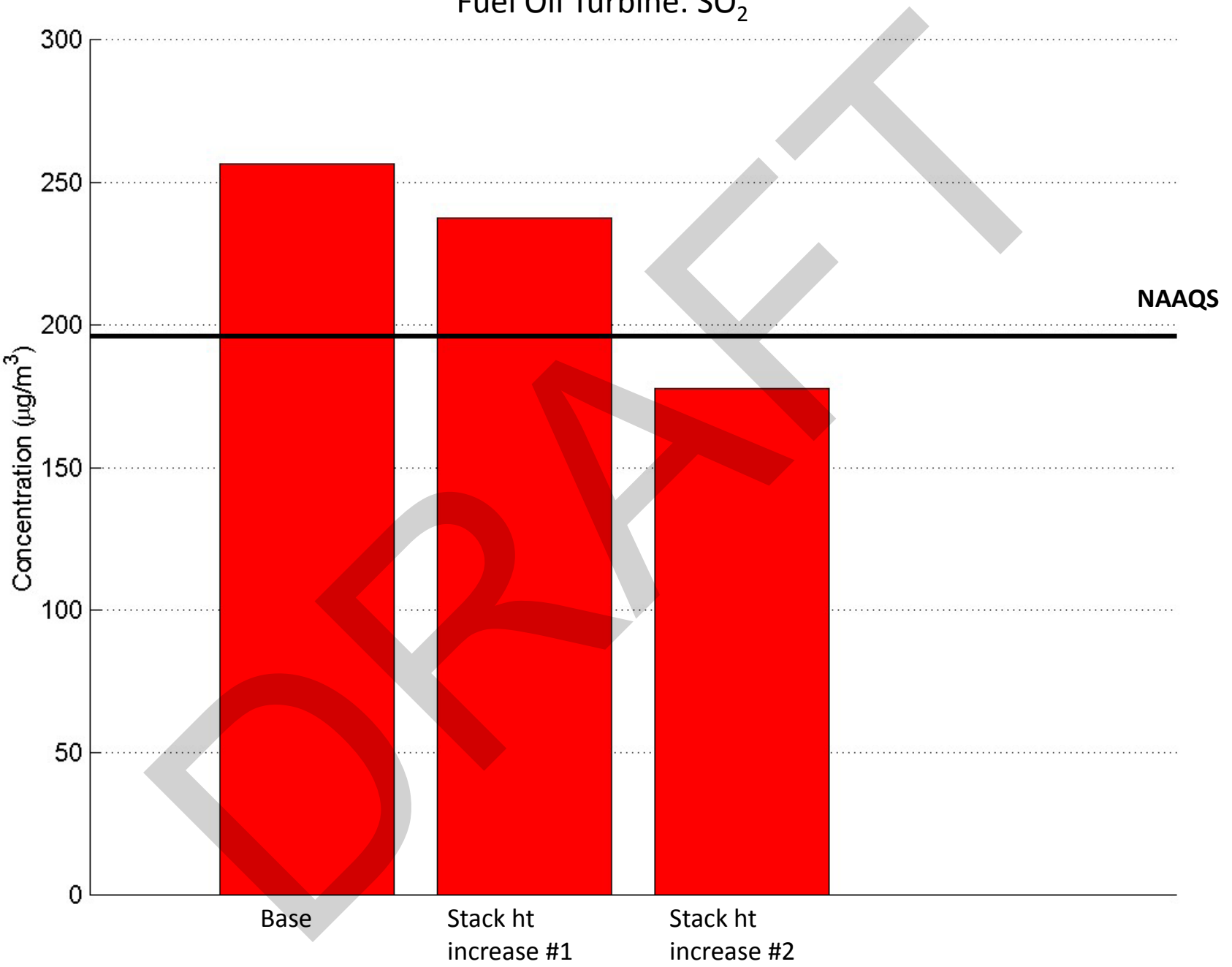

Base
Max DV: 924 µg/m3
Legend
15 - 25
26 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,500
1,501 - 1,539
0
750
1,500
3,000
4,500
6,000
Meters
DRAFT

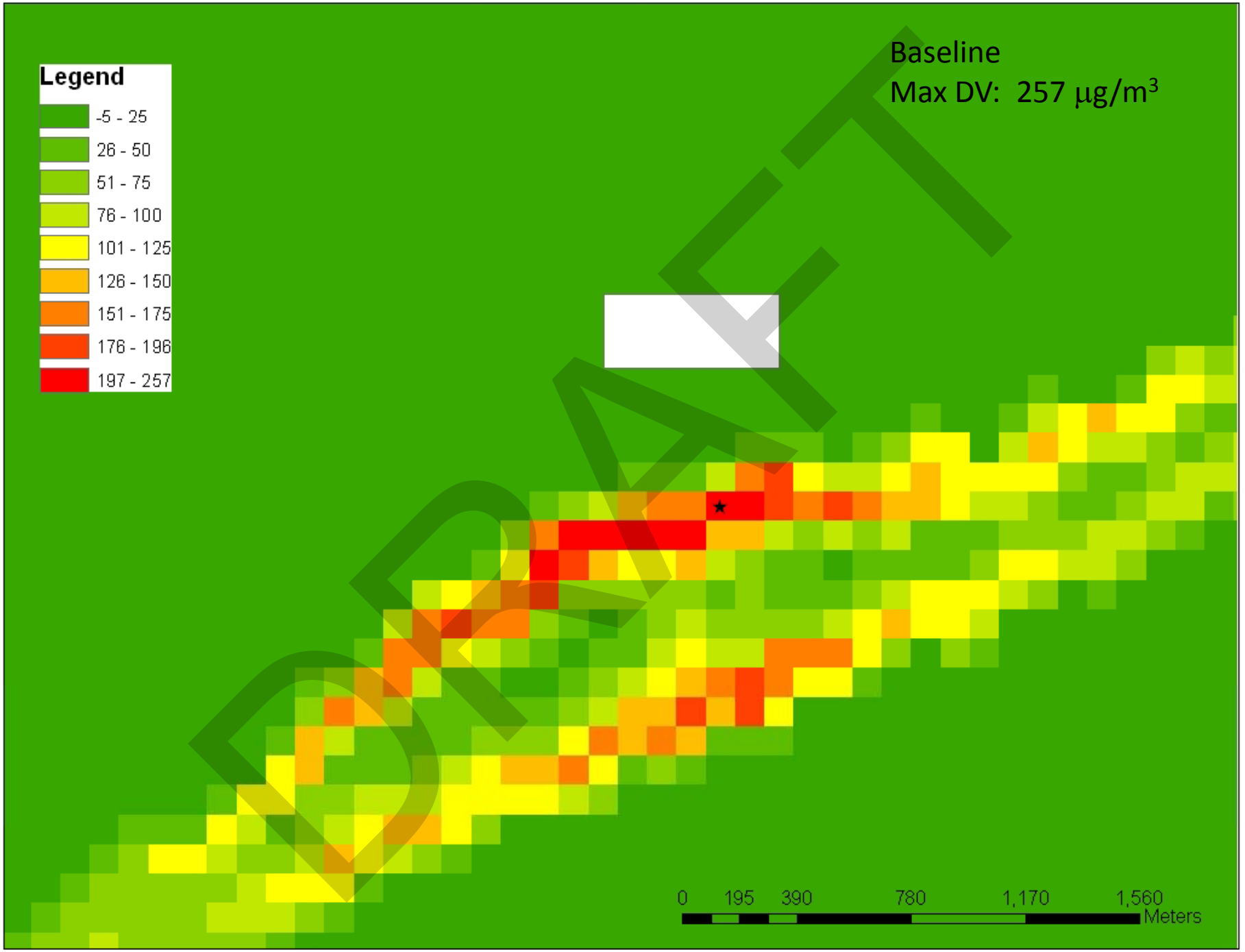

Stack ht increase #1
Max DV: 553 µg/m3
Legend
15 - 25
26 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,500
1,501 - 1,539
0
750
1,500
3,000
4,500
6,000
Meters
DRAFT

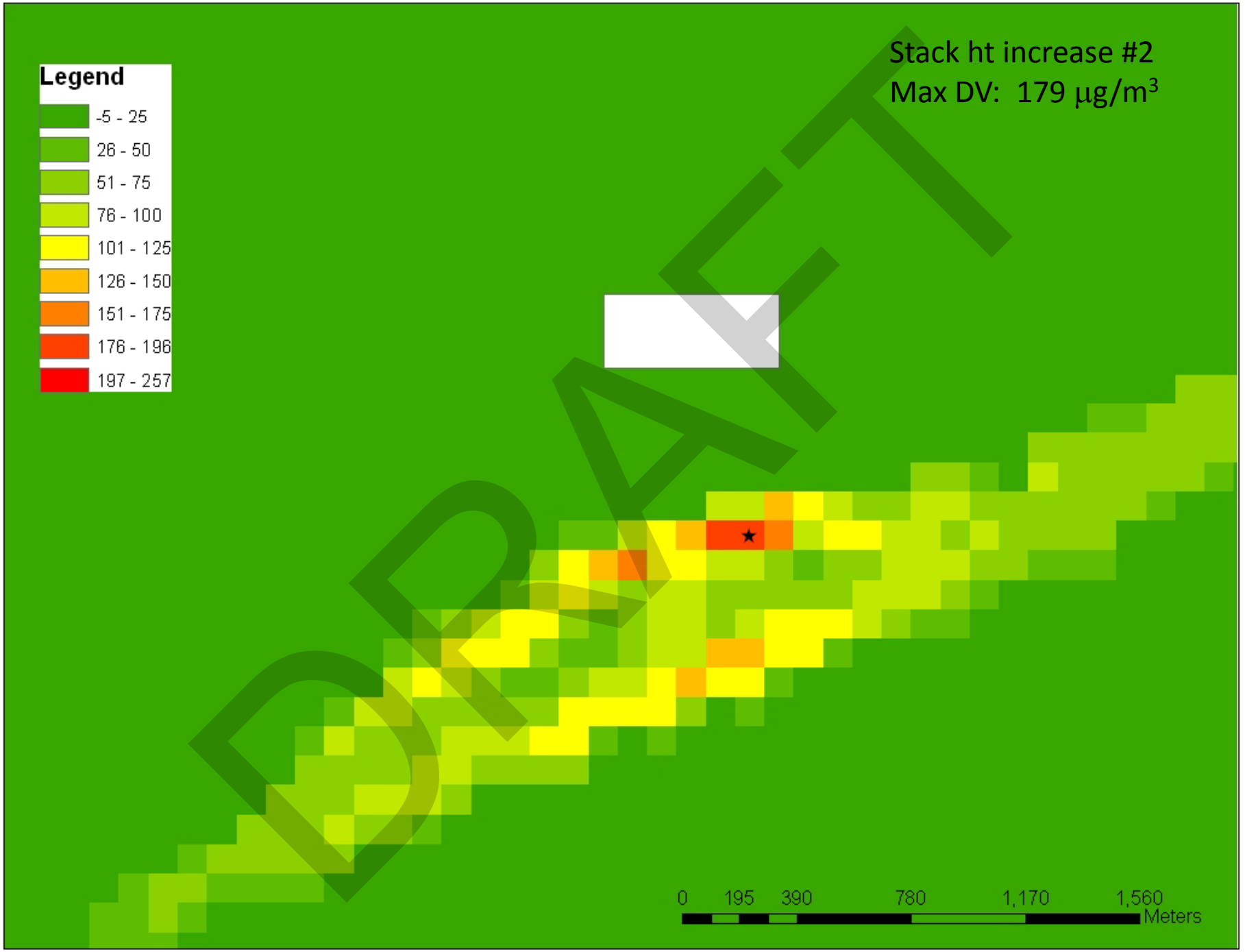

Stack ht increase #2
Max DV: 212 μg/m3
Legend
15 - 25
26 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,500
1,501 - 1,539
0
750
1,500
3,000
4,500
6,000
Meters
DRAFT

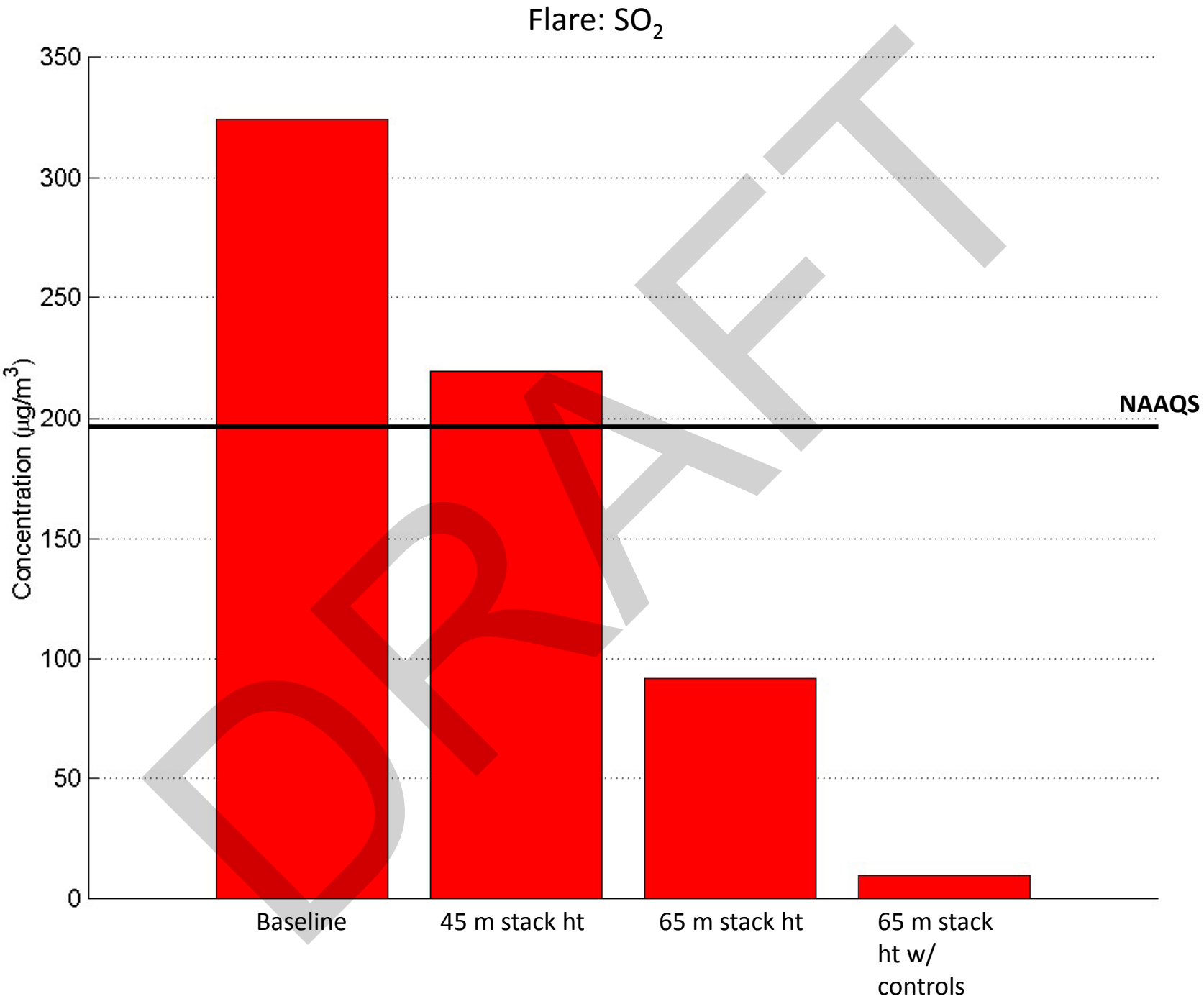

Stack ht increase #2 and controls
Max DV: 212 μg/m3
Legend
15 - 25
26 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 196
197 - 250
251 - 500
501 - 750
751 - 1,000
1,001 - 1,250
1,251 - 1,500
1,501 - 1,539
DRAFT
0
850
1,700
3,400
5,100
6,800
Meters

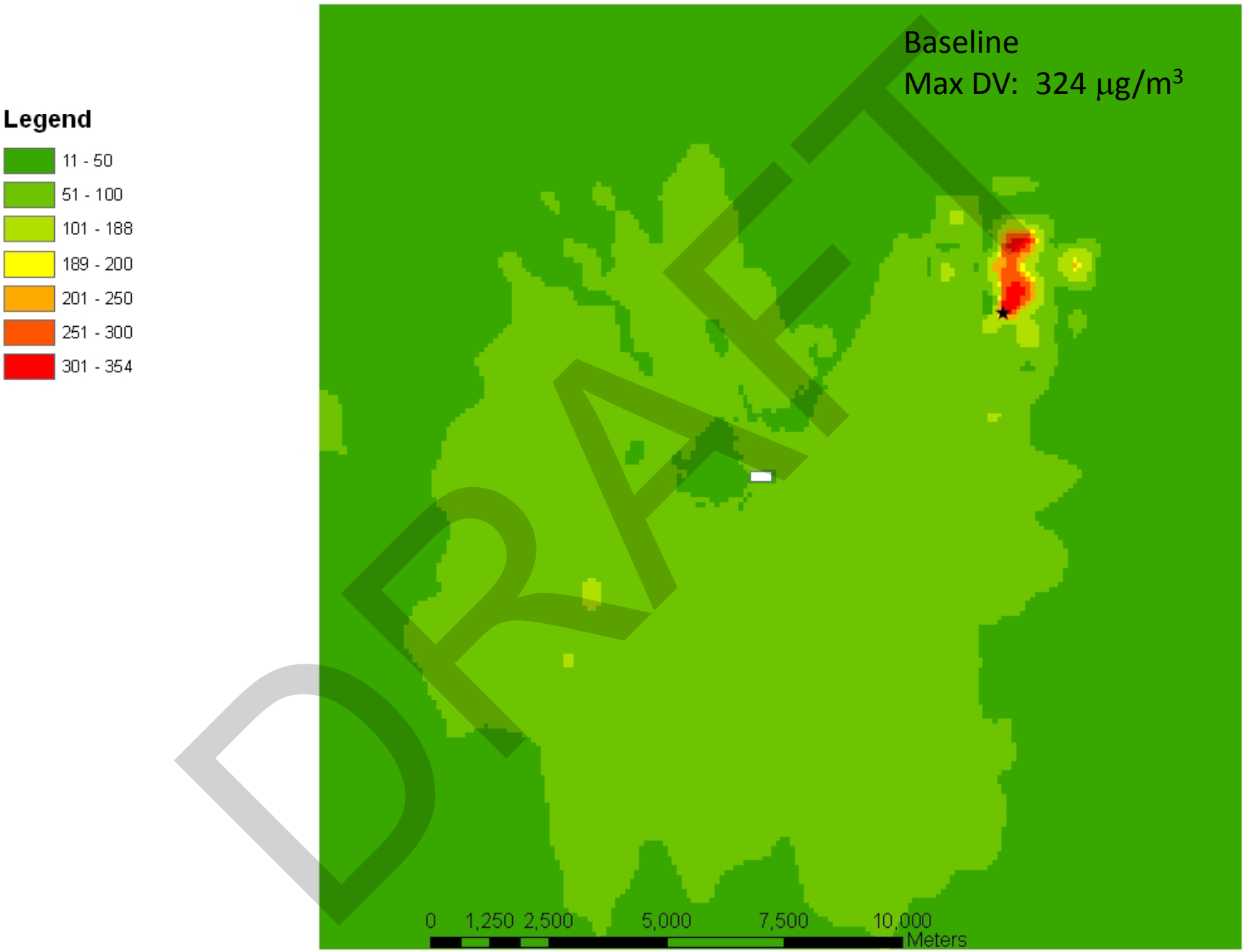

Landfill Gas Turbine: SO_2
200
180
160
140
120
100
80
60
40
20
0
Concentration (µg/m^3)
NAAQS
Baseline
Stack ht increase #1
Stack ht increase #2

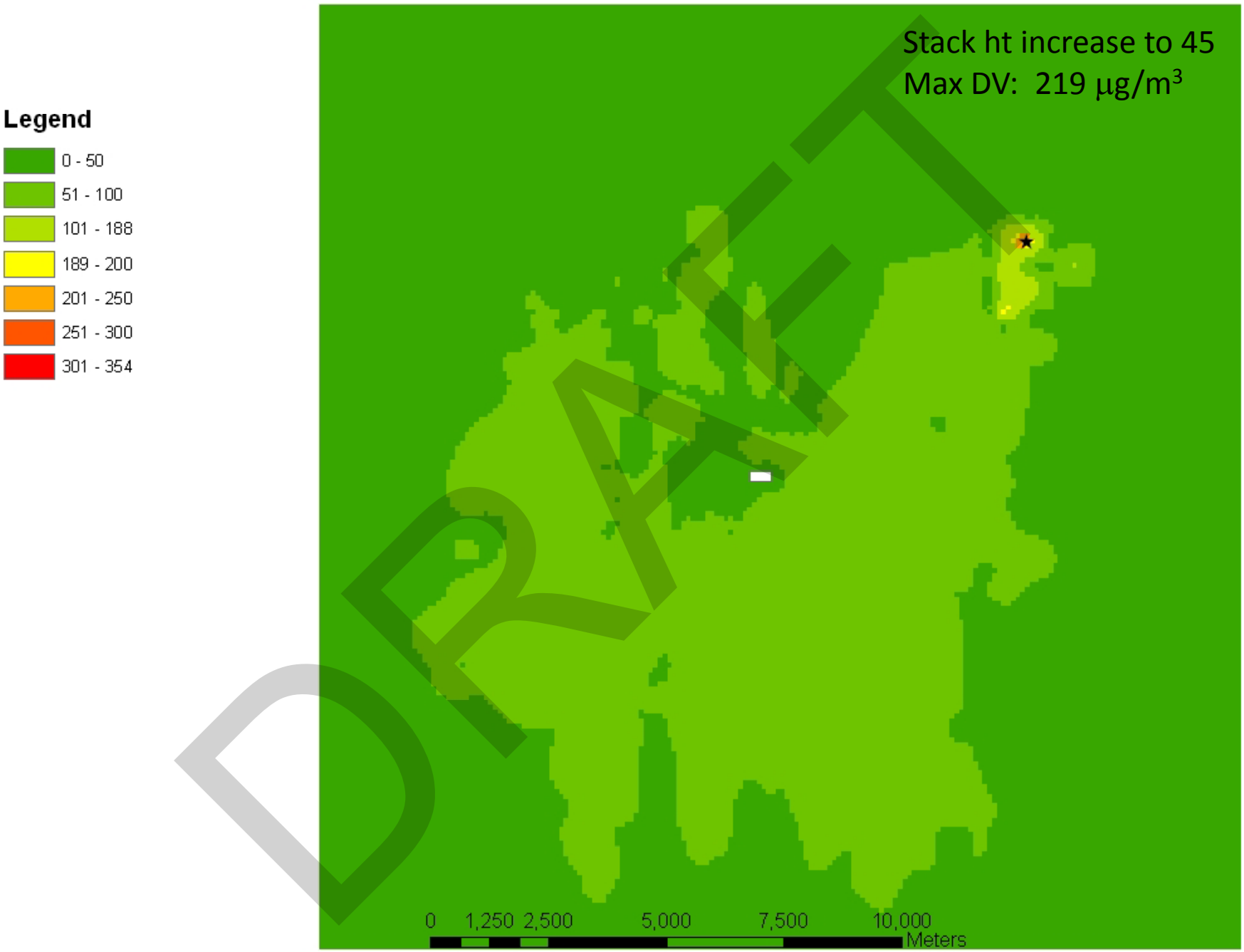

Fuel Oil Turbine: SO_2
300
250
200
150
100
50
0
Concentration (µg/m^3)
NAAQS
Base
Stack ht increase #1
Stack ht increase #2

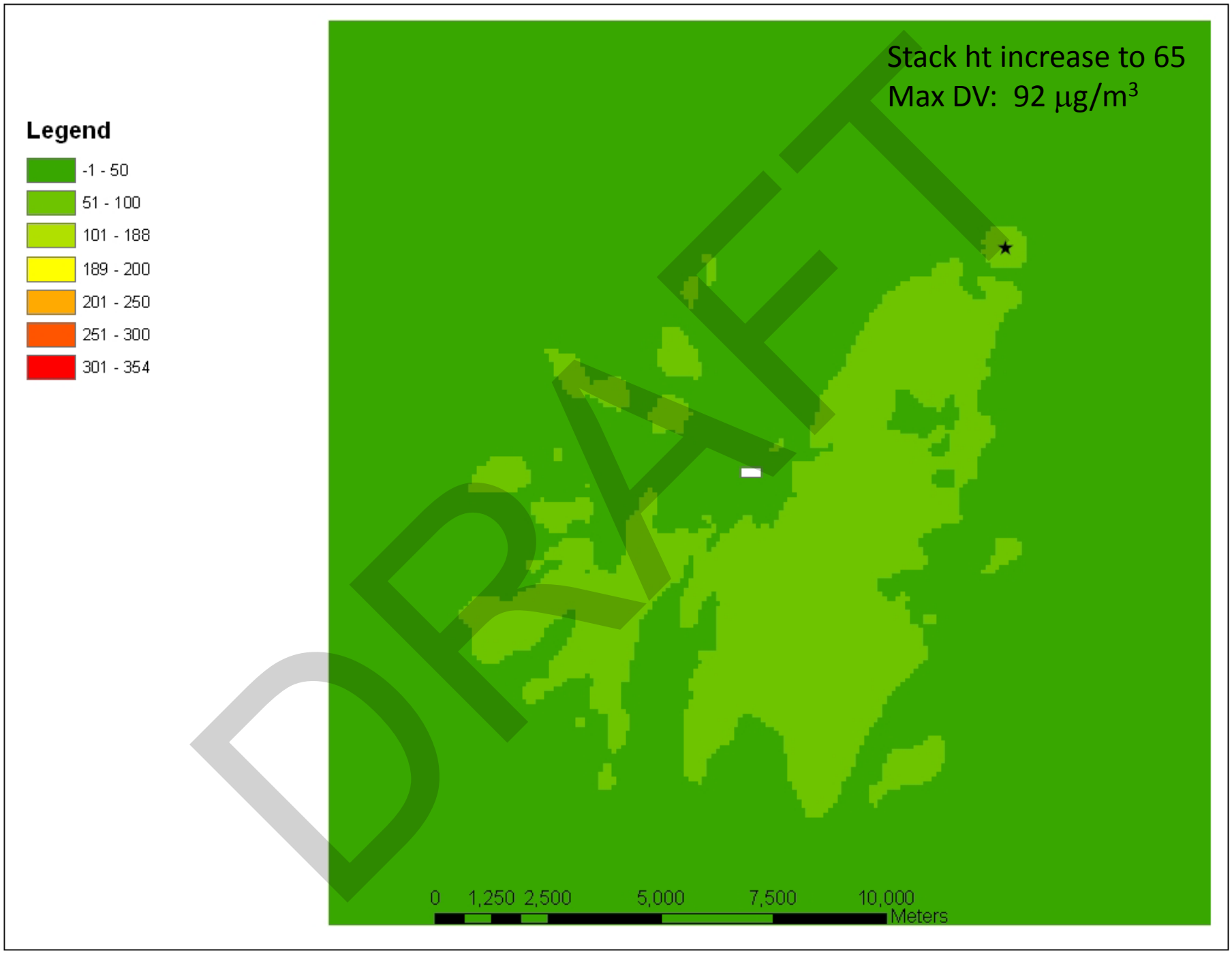

Legend
-5 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 175
176 - 196
197 - 257
Baseline
Max DV: 257 µg/m3
0
195
390
780
1,170
1,560
Meters


Legend
-5 - 25
26 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 175
176 - 196
197 - 257
Stack ht increase #2
Max DV: 179 µg/m3
DRAFT
0 195 390 780 1,170 1,560
Meters


Flare: SO2
350
300
250
200
150
100
50
0
Concentration (µg/m3)
NAAQS
Baseline
45 m stack ht
65 m stack ht
65 m stack ht w/ controls


Legend
11 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 354
Baseline
Max DV: 324 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
0 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 354
Stack ht increase to 45
Max DV: 219 µg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters


Legend
-1 - 50
51 - 100
101 - 188
189 - 200
201 - 250
251 - 300
301 - 354
Stack ht increase to 65
Max DV: 92 μg/m3
0 1,250 2,500 5,000 7,500 10,000
Meters