

APPENDIX N: COMPUTER MODEL STUDY 9:

A 40 ft. Deep Extension Was Added to the Range Structure in the Direction of Fire Sites 1 and 2 with the Base and Alternate Range Orientations Typical and Busy Day Scenarios 20 ft. tall berm

Computer model study 9 was conducted with side and rear walls added to the range structure so the firing positions were open only in the direction of fire. A 40 ft. deep extension was added to the roof/ceiling of the range structure with the underside of the roof lined with a sound absorbent panel mounted on plywood. The side and rear walls covered with the sound absorbent facing used in Computer Model Study 8 and the sound absorbent material on the inside face of the partitions dividing the individual lanes and ceiling described in Computer Model Study 7 were also included in this scenario. The models were run on Site 1: County Road Commission with the direction of fire to the north and to the north-northwest for the “busy day” scenario and Site 2: Sands West with the direction of fire to the north, northwest, and southwest with the “busy day” scenario.

1. The “busy day” scenario has 1 shooter on the 50 yard range, 200 yard range and on the 300 yard range firing a .223 rifle, one shooter on the 40 yard range firing a 12 gauge shotgun and 2 shooters on the 25 yard range firing 0.40 caliber handguns.
2. The “typical day” scenario has one shooter on the 300 yard range firing a .223 rifle; one shooter on the 40 yard range firing a 12 gauge shotgun and one shooter on the 25 yard range firing a 0.40 caliber handgun in the same one second time period.
3. The wind condition in the base model was modeled as downwind with 1 to 11 mph wind as the other in computer model studies 1 and 2.
4. The 50°F and 80% relative humidity condition was used in the models.
5. A 40 ft. deep extension was added to the range structure. The underside of the extension was lined with a sound absorbent material installed over plywood.
6. The side walls and rear wall of the range structure were also included in this model so that the range was only open in the direction of fire. Wood frame walls were built between each firing lane with plywood covering. Sound absorbent panels were installed on the sides and ceiling of each lane as well as on the side and rear walls of the entire range structure as in Computer Model Studies 7 and 8.
7. The direction of fire was to the north and to the north-northwest for Site 1; and to the north, northwest and southwest for Site 2.
8. The berm height of 20 ft. was used in the reference model.
9. The sound levels shown on the noise contour maps are LAeq in dBA.

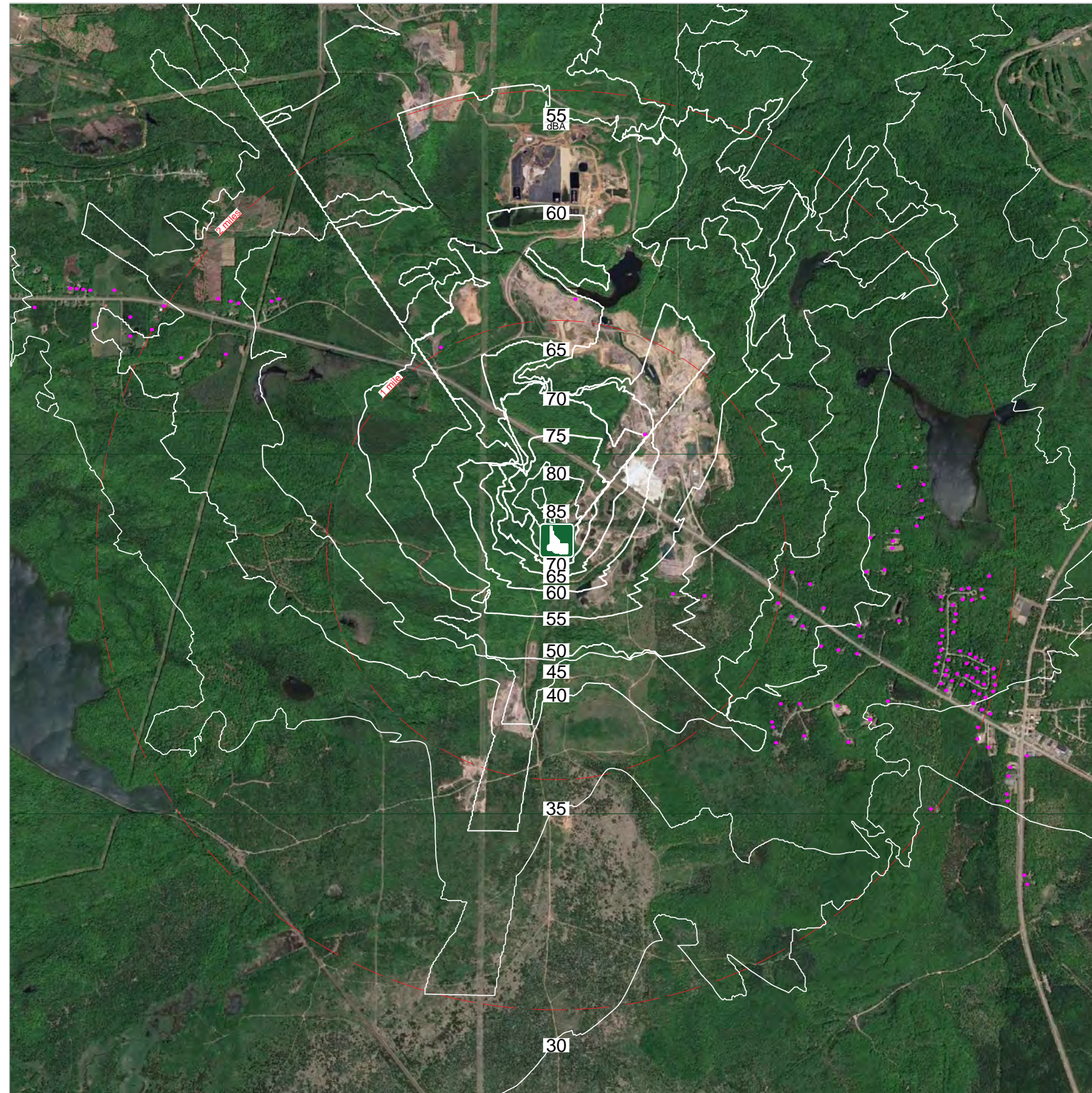
In Experiment 9, a 40 ft. deep roof lined with sound absorbent material was constructed on the down range side of the range building in addition to the solid side walls and rear wall that were added to the range building in Experiment 8 and the solid dividers are installed between each lane in Experiment 7 in the Site 1: County Road Commission range oriented to the north and to the north-northwest and Site 2: Sands West range oriented to the north, northwest, and southwest with the 20 ft. tall downrange berm and the “busy day” scenario in Experiment 7.

A sound absorbent lining panel is added to the rear wall, side walls, interior lane dividing walls and the ceiling of each lane in the range building. This locates each shooter in a sound absorbent enclosure on 3 sides with a 40 ft. deep roof structure that reduces sound propagating out of the range building.

The linear pressure score is reduced by approximately 90% for the Site 1: County Road Commission range oriented to the northwest and by 95% for the Site 2: Sands West range oriented to the northwest. The rough order of magnitude cost for installing the 40 ft. extension of the roof, the side walls, rear wall, solid dividers in each of the lanes and lining the ceiling and walls of each lane with a weather-resistant sound absorbing panel such as Troy Board manufactured by Troy Acoustics is \$440,600 and \$233,900 for increasing the height of the berm to 20 feet tall for a total increase in cost of \$674,500 compared to the base range design.

Table N-1. Summary table of rating points for each scenario tested in Experiment 9.

BUSY DAY 6 SHOOTERS 20 FT BERM				
Site	DOF	LIN PRES	dB	PTS
SITE 1: MCRC	NNW	122	71	299
SITE 2: Sands	NW	133	71	601
SITE 1: MCRC	N	274	74	329
SITE 2: Sands	N	277	74	714
SITE 2: Sands	SW	289	75	555
SITE 1: MCRC Reference	N	850	79	298
SITE 2: Sands Reference	N	2,415	84	1149
TYPICAL DAY 3 SHOOTERS 20 FT BERM				
Site	DOF	LIN PRES	dB	PTS
SITE 2: Sands	NW	52	67	637
SITE 1: MCRC	NNW	81	69	232
SITE 1: MCRC	N	102	70	255
SITE 2: Sands	SW	108	70	553
SITE 2: Sands	N	146	72	818
SITE 1: MCRC Reference	N	359	76	354
SITE 2: Sands Reference	N	989	80	992



MARQUETTE CRC
MODEL N-1

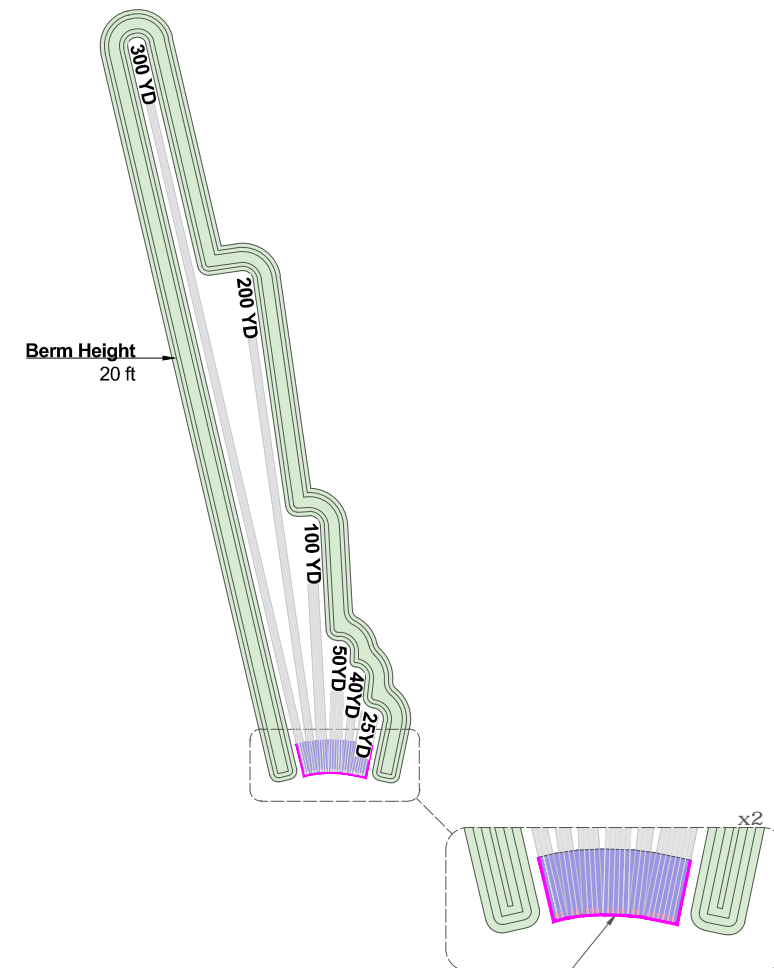
- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

Typical Day:
 Shooters within 1 second:
 1 Rifle
 1 Shotgun
 1 Handgun

D.O.F. N

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on dividing panels between each firing lane, rear and side walls.



MARQUETTE CRC
MODEL N-2

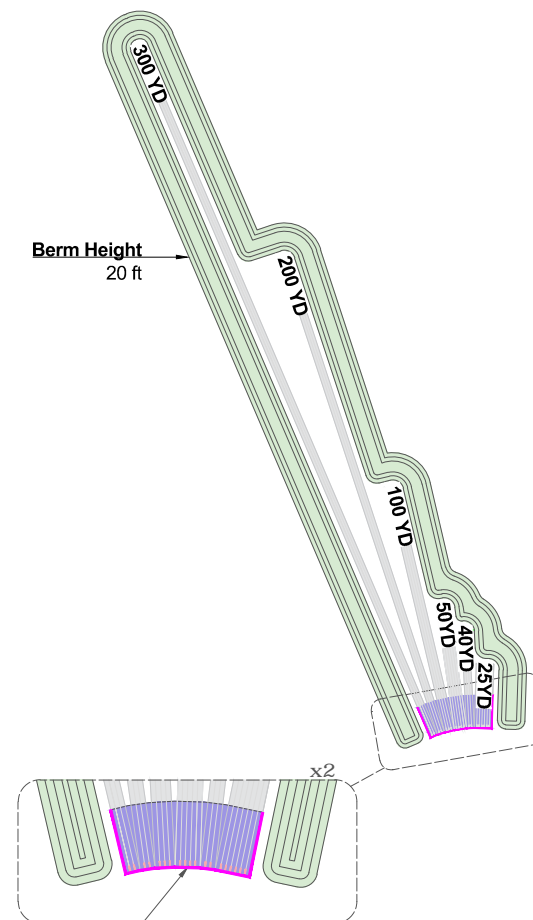
20 ft. Tall Side Berms
 40 ft. Extended Roof
 Sound absorbing canopy and dividers
 Structure with rear and side walls

Typical Day:
 Shooters within 1 second:
 1 Rifle
 1 Shotgun
 1 Handgun

D.O.F. NNW

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on diving panels between each firing lane, rear and side walls.



MARQUETTE CRC
MODEL N-3

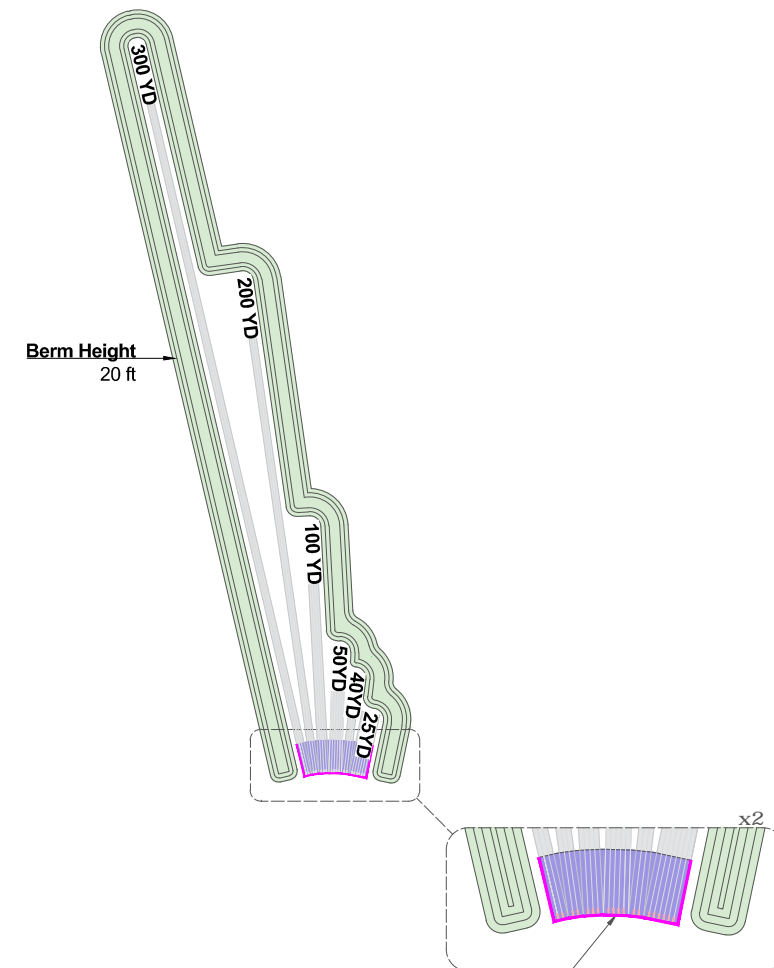
20 ft. Tall Side Berms
 40 ft. Extended Roof
 Sound absorbing canopy and dividers
 Structure with rear and side walls

Busy Day:
 Shooters within 1 second:
 3 Rifles
 1 Shotgun
 2 Handguns

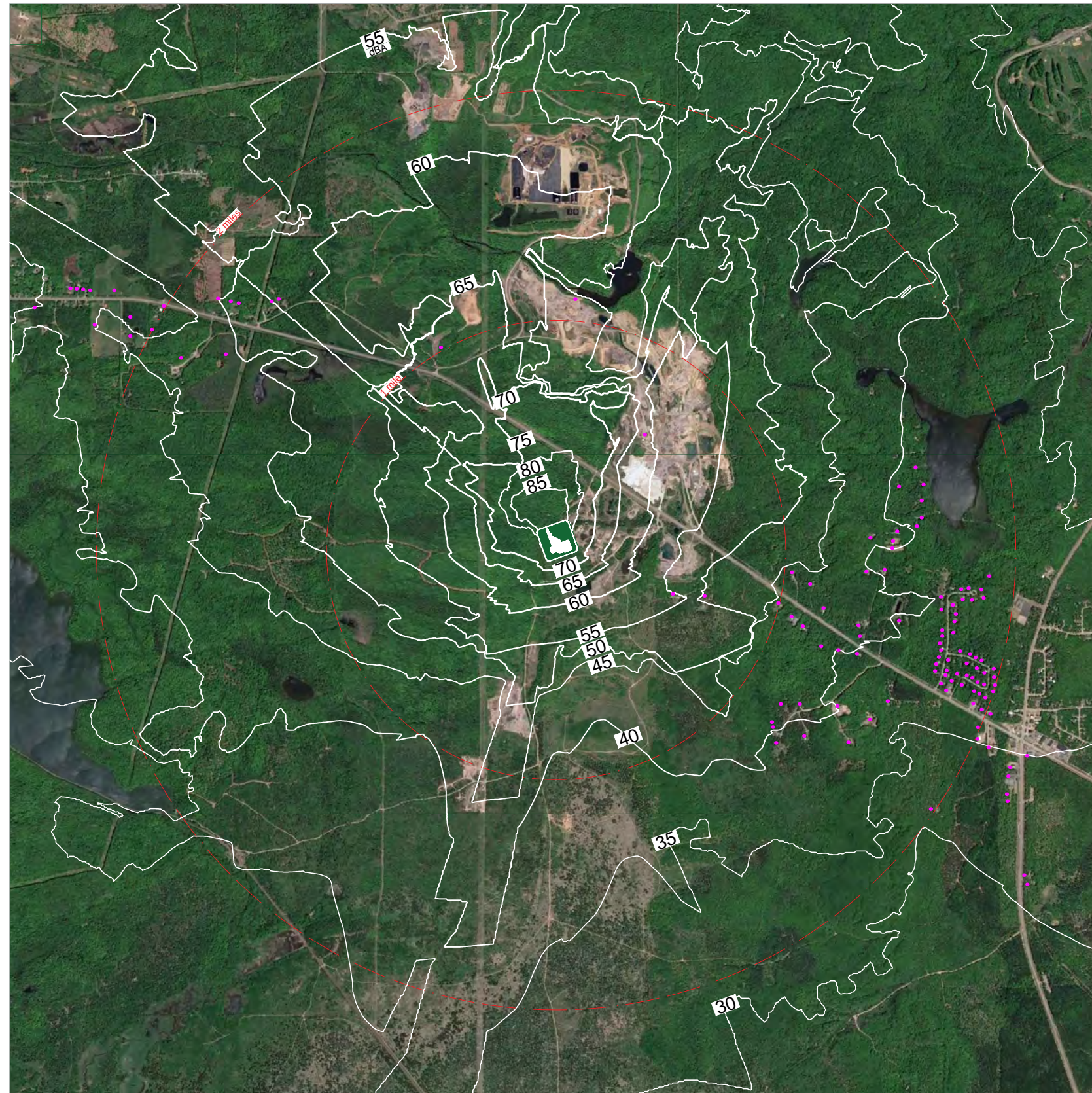
D.O.F. N

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on dividing panels between each firing lane, rear and side walls.



MARQUETTE CRC
MODEL N-4

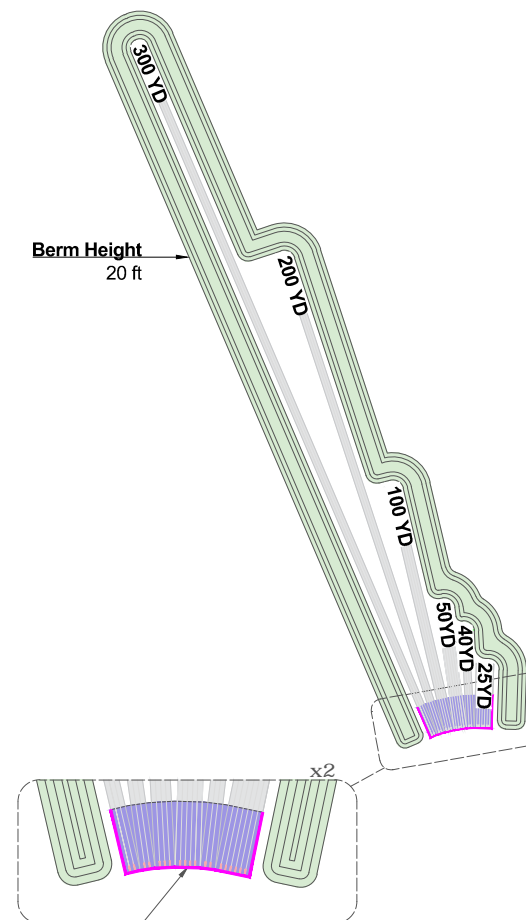
20 ft. Tall Side Berms
 40 ft. Extended Roof
 Sound absorbing canopy and dividers
 Structure with rear and side walls

Busy Day:
 Shooters within 1 second:
 3 Rifles
 1 Shotgun
 2 Handguns

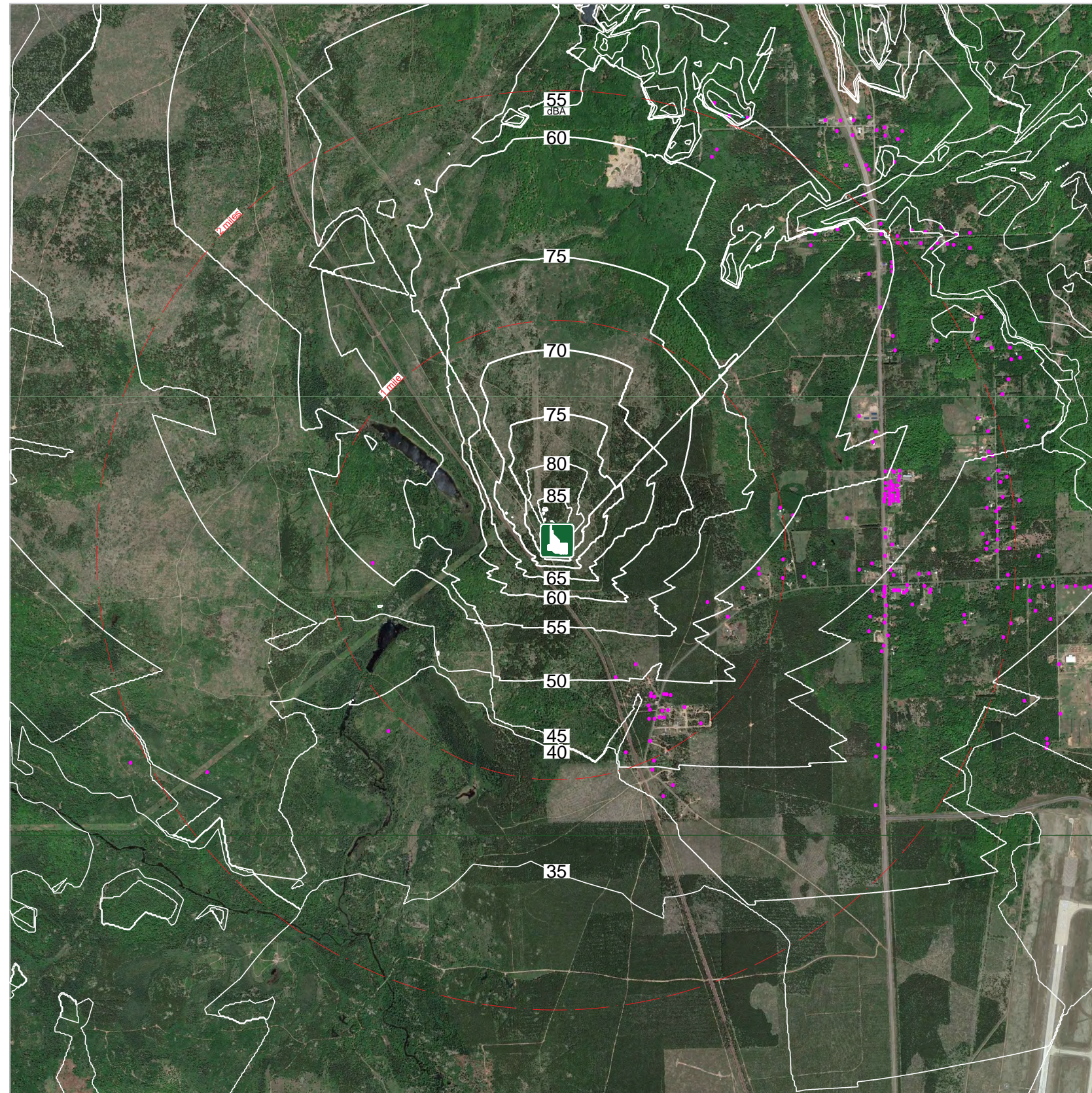
D.O.F. NNW

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on diving panels between each firing lane, rear and side walls.



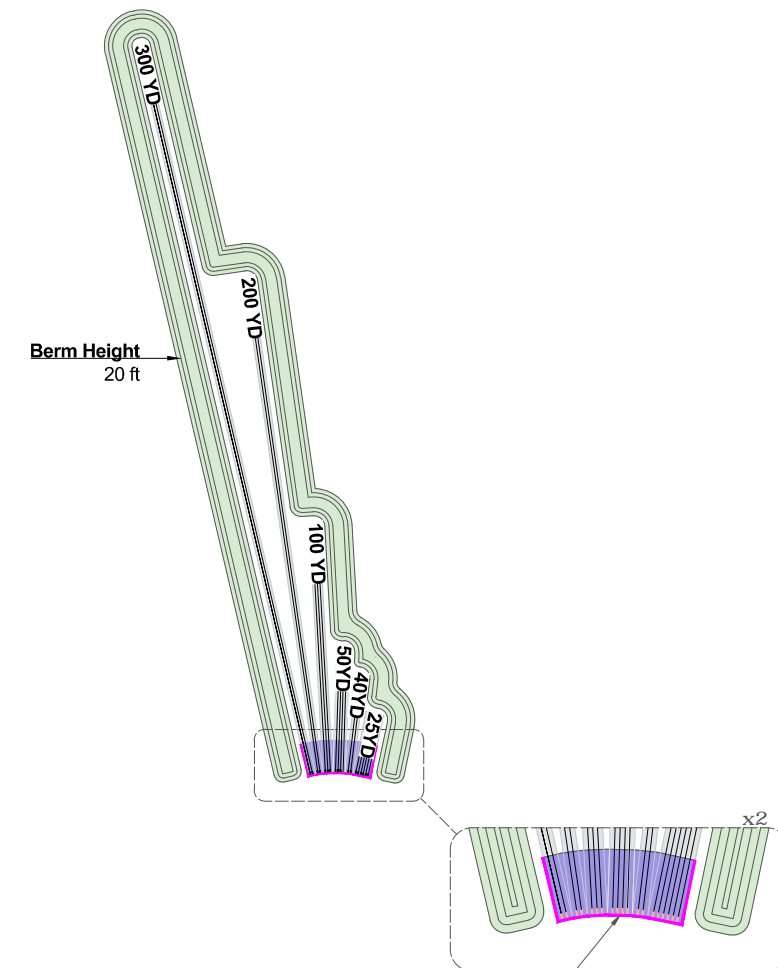
SANDS
MODEL N-5

- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

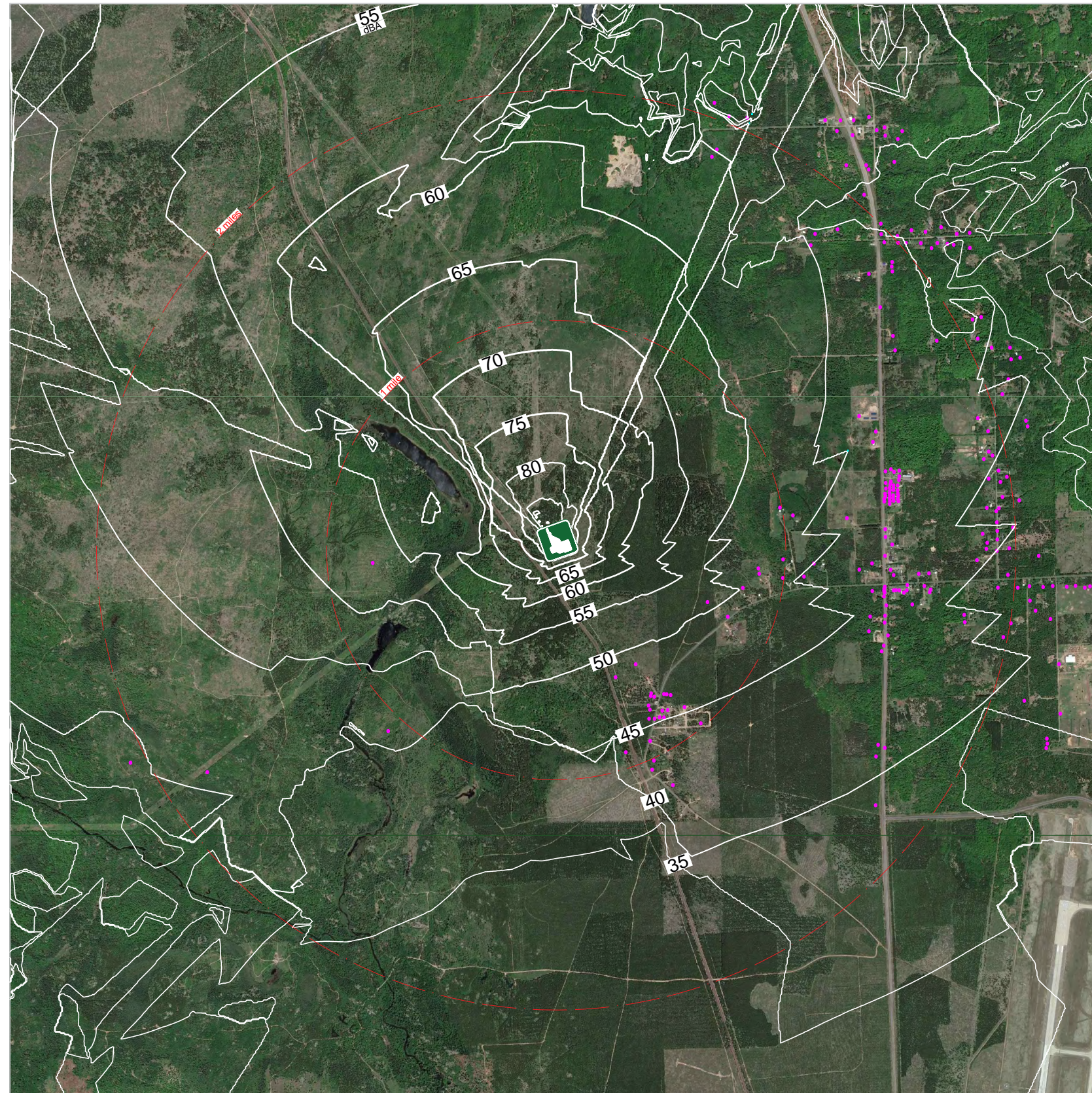
Typical Day:
 Shooters within 1 second:
 1 Rifle
 1 Shotgun
 1 Handgun

D.O.F. N

Wind: 1 to 11 mph downward
 50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on dividing panels between each firing lane, rear and side walls.



**SANDS
 MODEL N-6**

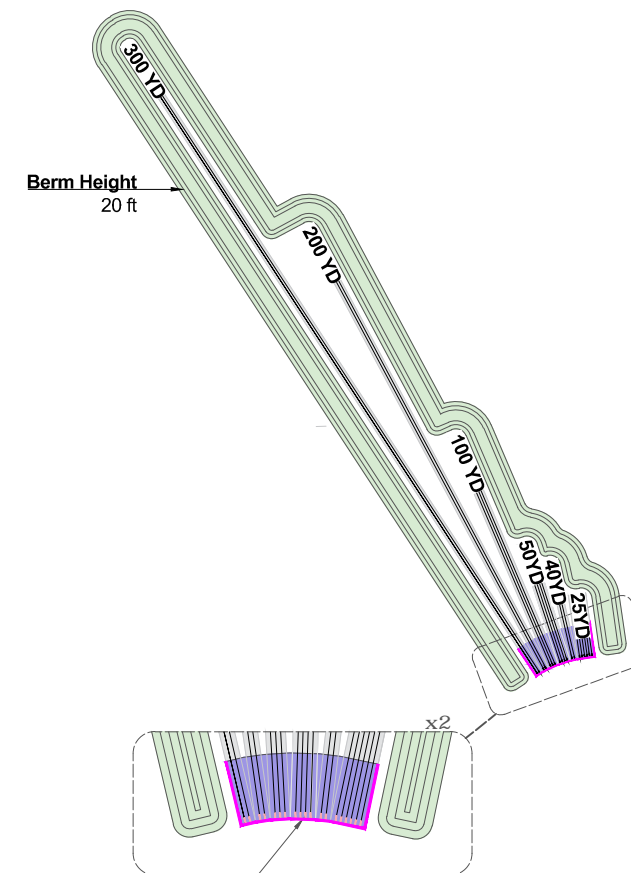
- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

Typical Day:
 Shooters within 1 second:
 1 Rifle
 1 Shotgun
 1 Handgun

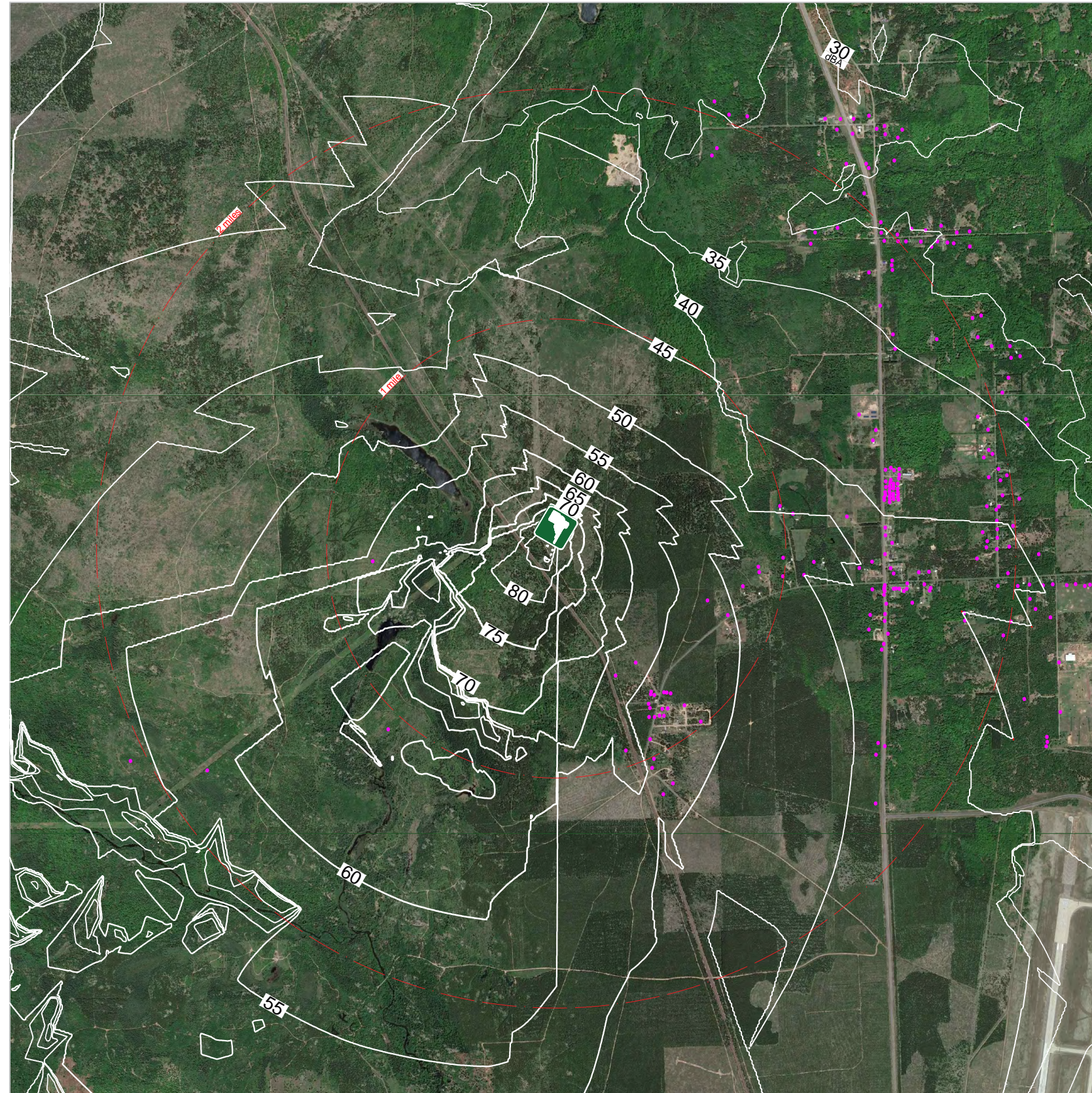
D.O.F. NW

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on diving panels between each firing lane, rear and side walls.



**SANDS
 MODEL N-7**

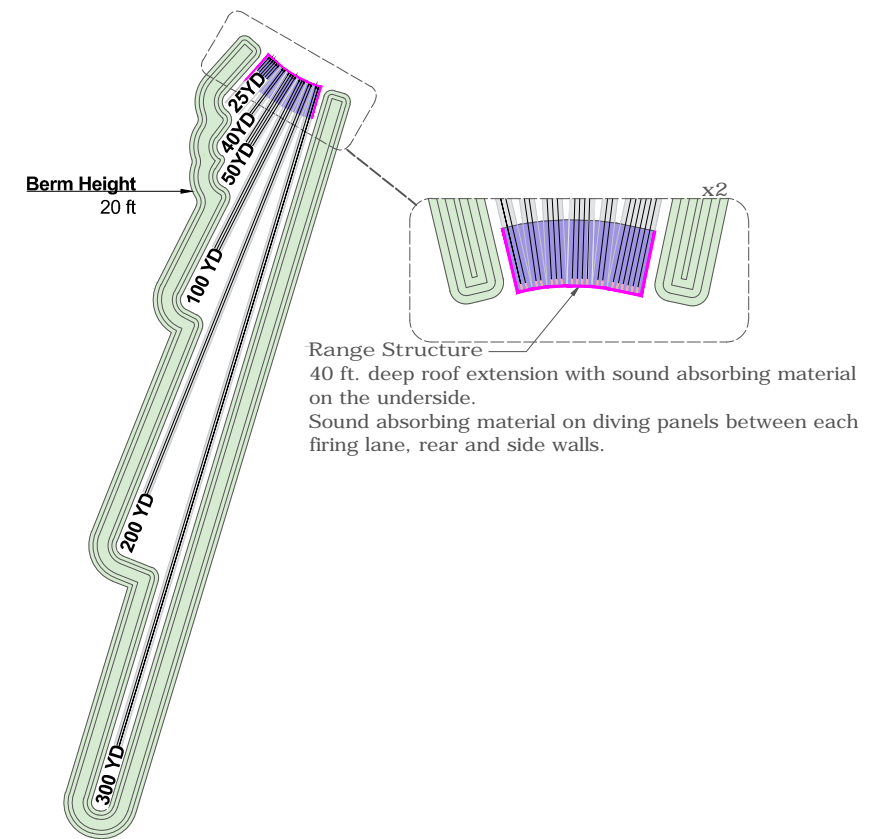
- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

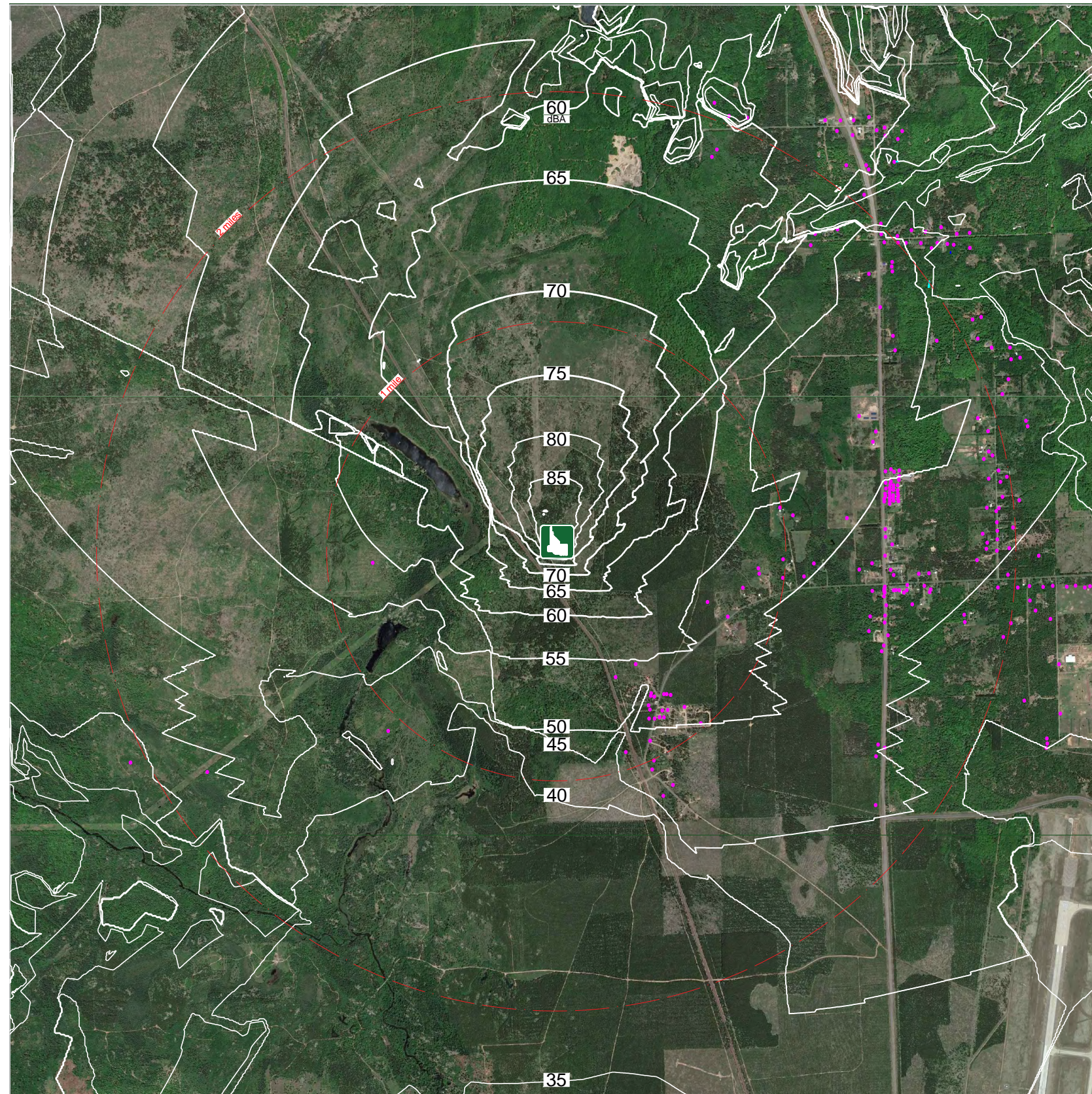
Typical Day:
 Shooters within 1 second:
 1 Rifle
 1 Shotgun
 1 Handgun

D.O.F. SW

Wind: 1 to 11 mph downward

50°F and 80% R.H.





**SANDS
 MODEL N-8**

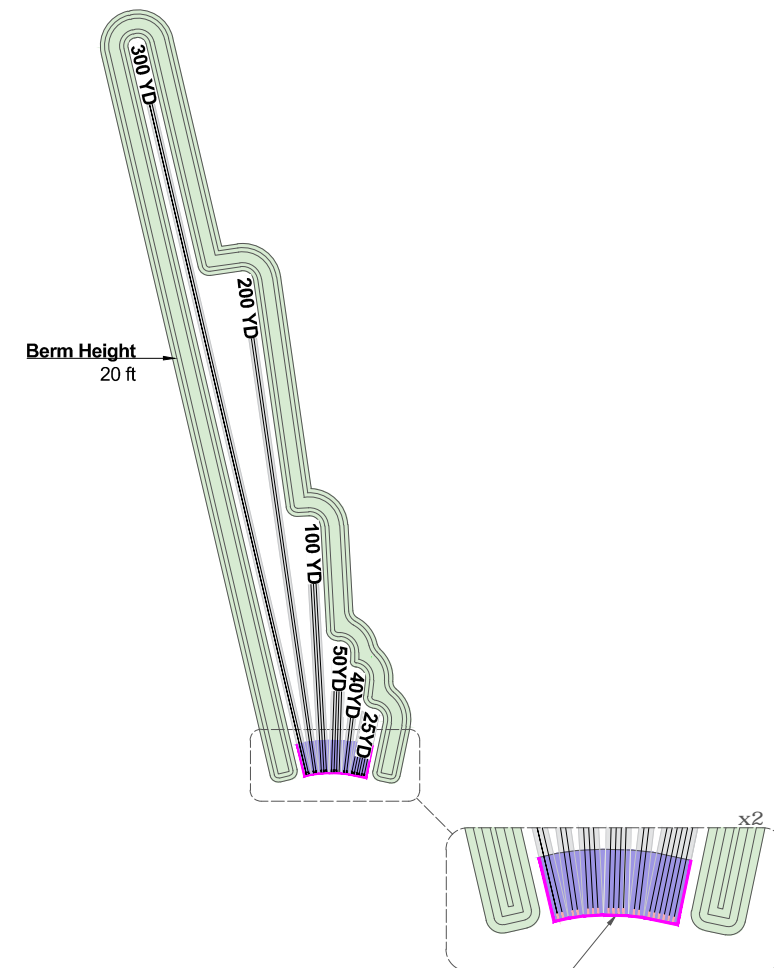
- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

- Busy Day:**
 Shooters within 1 second:
 3 Rifles
 1 Shotgun
 2 Handguns

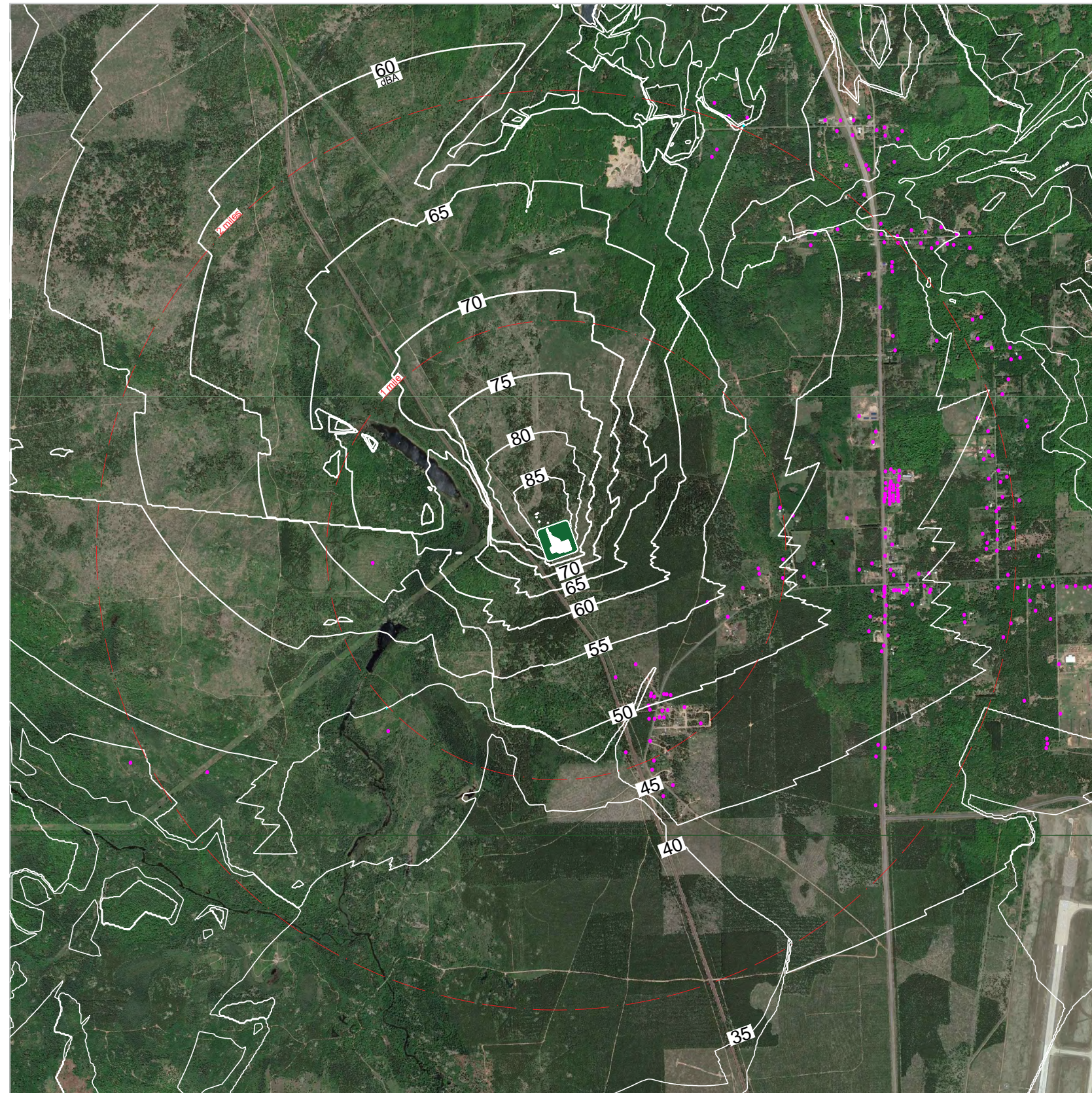
D.O.F. N

Wind: 1 to 11 mph downward

50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on diving panels between each firing lane, rear and side walls.



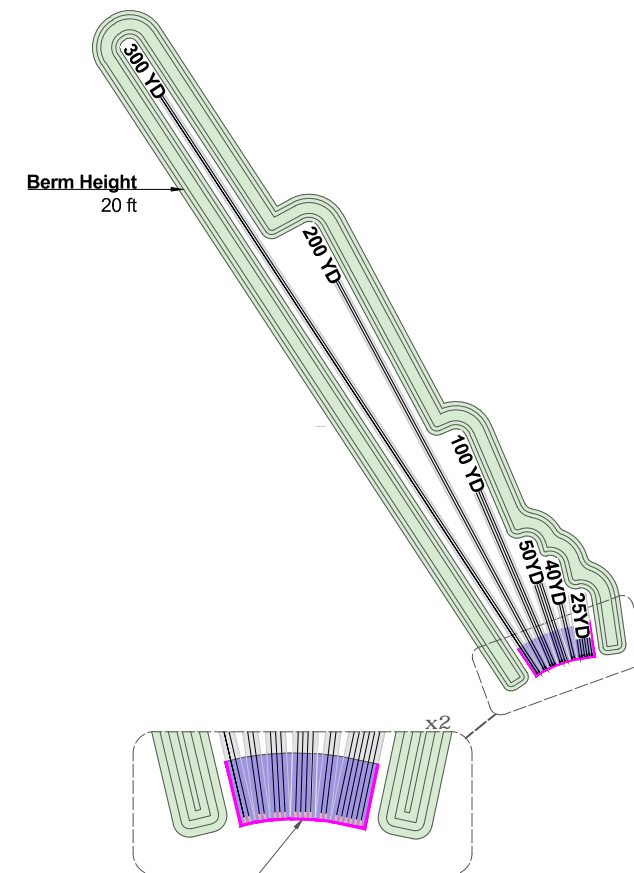
**SANDS
 MODEL N-9**

- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

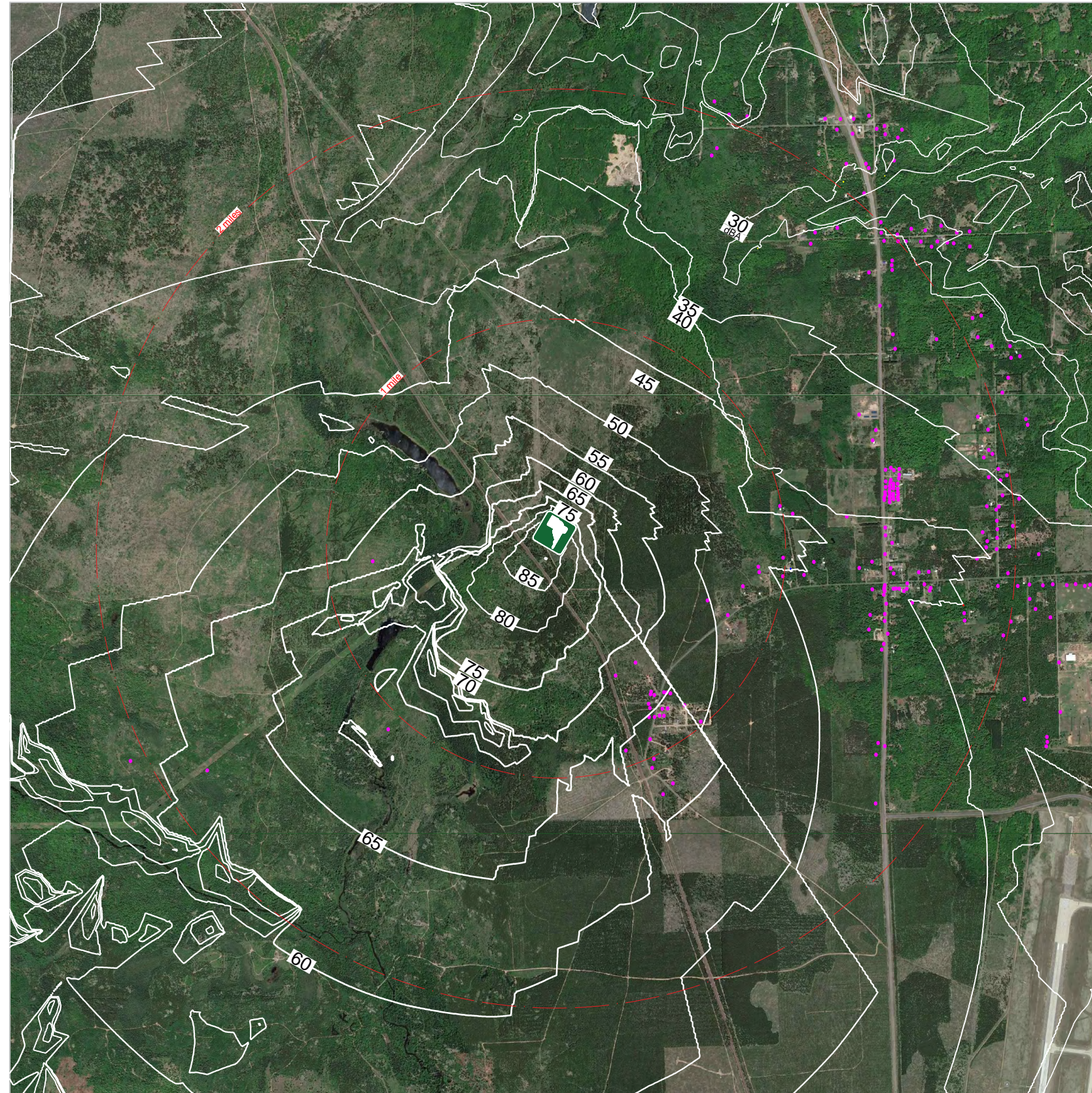
Busy Day:
 Shooters within 1 second:
 3 Rifles
 1 Shotgun
 2 Handguns

D.O.F. NW

Wind: 1 to 11 mph downward
 50°F and 80% R.H.



Range Structure
 40 ft. deep roof extension with sound absorbing material on the underside.
 Sound absorbing material on diving panels between each firing lane, rear and side walls.



**SANDS
 MODEL N-10**

- 20 ft. Tall Side Berms
- 40 ft. Extended Roof
- Sound absorbing canopy and dividers
- Structure with rear and side walls

Busy Day:
 Shooters within 1 second:
 3 Rifles
 1 Shotgun
 2 Handguns

D.O.F. SW

Wind: 1 to 11 mph downward
 50°F and 80% R.H.

