

# Department of Defense Explosives Safety Board (DDESB)



## Explosives Safety and Munitions Risk Management (ESMRM) Assessment Examples

August 2018



# Training Session Objectives

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- Educate symposium on DDESB roles, functions, resident expertise, and support capabilities
- Provide insight into current DoD Explosives Safety Munitions Risk Management (ESMRM) policy
- Educate participants on the ESMRM Assessment process
- Gain forum participants perspective on explosives safety and risk management
- Serve as exchange venue for explosives safety best practices; trends; procedures; and lessons learned for applicability within and across forum participants



# Training Session Agenda

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- Intro Brief
- ESMRM Policy
- Technical Paper 23 Overview
- ESMRM Assessment Process
- **ESMRM Assessment Examples**
- ESS risk based capabilities in ESS 6.1.4



# ESMRM Assessment Process Agenda

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- ESMRM Assessment Purpose
- ESMRM Assessment Tools
- Munitions Risk Assessment System (MRAS)
- Munitions Risk Assessment System Example



# ESMRM Assessment Purpose

- To identify, analyze, and reduce munitions-related risks in support of DoD explosives safety policy tenets:
  - To protect personnel and property from the potentially-damaging effects of DoD military munitions
  - To expose the minimum number of people for the minimum time to the minimum amount of DoD military munitions required to safely and effectively execute the mission
- Explosives safety is a critical function where the Combatant Commander (CCDR) can influence decisions relating to identifying and reducing munitions-related risks
- Planning for risks and potential consequences from the unintended initiation of DoD military munitions, procedures, and processes provides commanders the necessary information needed to make informed risk decisions based on ESMRM principles and contributes to mission success

*The foundational premise of ESMRM involves upfront identification and clear communication, to the appropriate level of command, of the risks and consequences to and from DoD military munitions during all phases of military planning, training, and operations*



# ESMRM Assessment Purpose

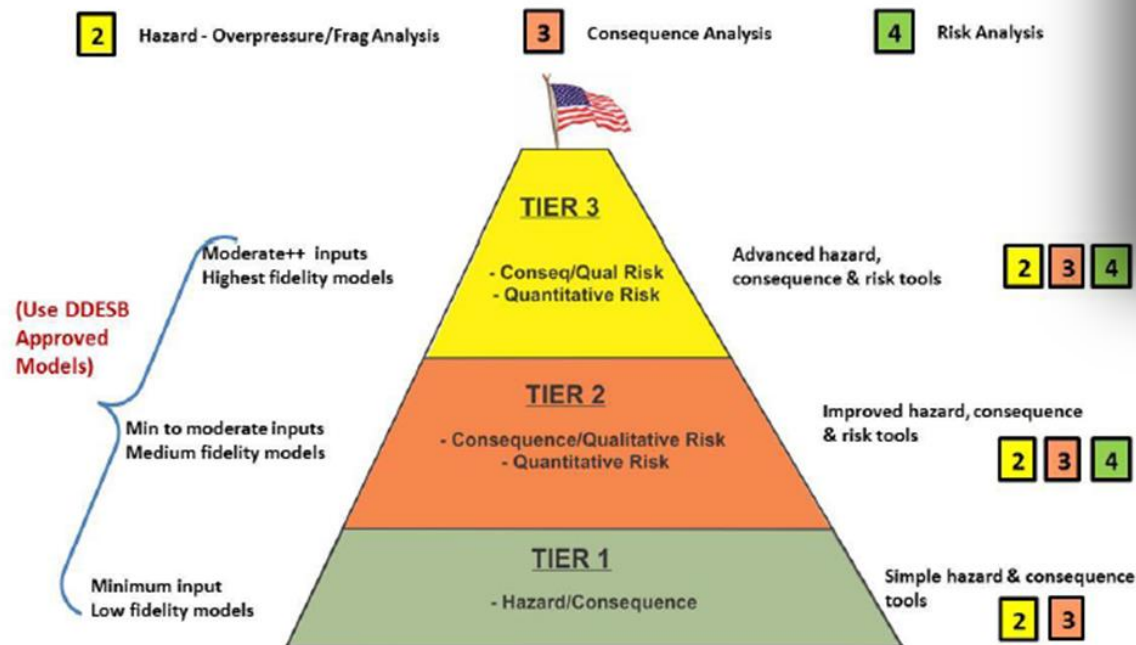
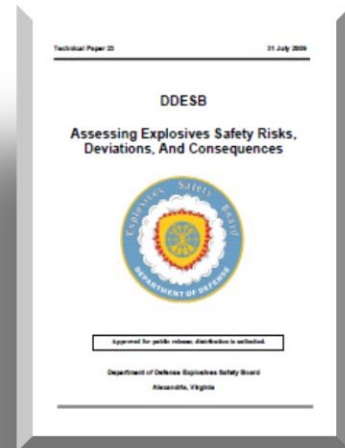
- ESMRMs analyze potential consequences of an incident...estimates:
  - Personnel exposure, to include potential fatalities and injuries
  - Infrastructure exposures and associated costs
  - Operational impact due to loss/damaged equipment/infrastructure
- ESMRM Assessment analyze risks **to and from** explosives and munitions and their related operations
- Assessment and the qualitative measure used to identify the hazard severity will be coordinated for approval as a single package to:
  - Risk decision authority
  - Responsible Combatant Commander (CCDR)
  - Service
  - DDESB

***Primary: Inform leaders/decision authorities of the risk associated with explosives and/or munitions based on the potential consequence associated with an explosives incident...when DoD explosives safety requirements cannot be met.***



# ESMRM Assessment Tools

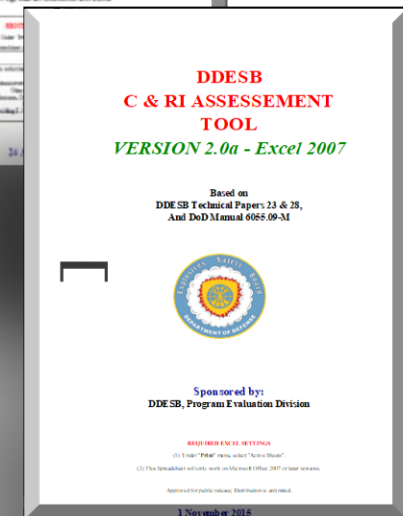
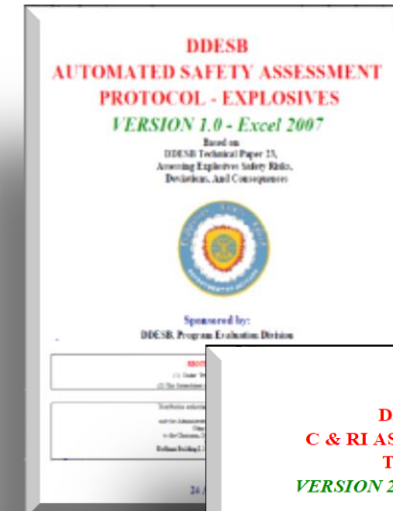
- The DDESB has developed and evaluated several risk analysis tools to facilitate risk based siting and munitions risk assessments.
- DDESB's TP 23 *Assessing Explosives Safety Risks, Deviations, And Consequences* provides an overview of tools available to perform munitions risk assessments.





# ESMRRM Assessment Tools

- The *Automated Safety Assessment Protocol – Explosives (ASAP-X)* and the *Consequence & Risk Identification (C&RI)* tool:
  - Tier one tool:
    - ✓ Analyzes Potential Explosion Site (PES) (ECM, Open, Other) to Exposed Sites (ESs)
    - ✓ Analyzes consequences based on overpressure and fragmentation based on K-factors (K-6, K-9, K-11, K-18, K-24, K-40/K-50)
    - ✓ Estimates fatalities, injuries, and infrastructure losses
    - ✓ This is a consequence tool that doesn't take into consideration the probability of event
    - ✓ Excel Spreadsheet based
- Currently the primary tool used to conduct ESMRRM Assessments



*ASAP-X was developed to assist in the risk assessment process, the derived information may be presented to leadership for review with the deviation package. It provides the information necessary to assist leaders in making informed risk decisions.*

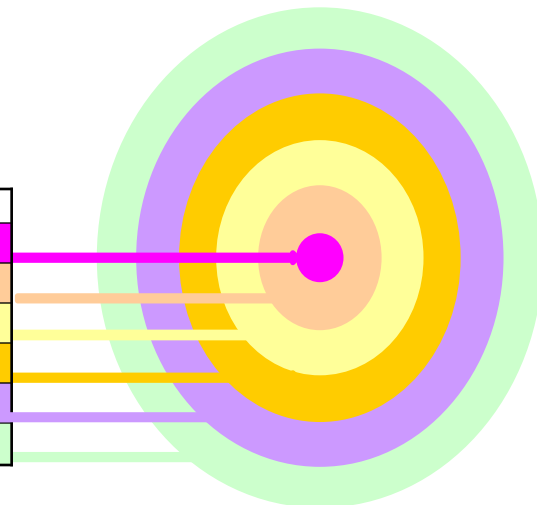




# ESMRM Assessment Tools

- *Consequence & Risk Identification (C&RI) tool (Cont.)*
  - Estimates the potential number of fatalities, injuries, and infrastructure damage
  - The C&RI tool doesn't take into consideration the probability of event nor PES orientation when calculating risks
  - The tool is currently Excel spreadsheet based and is being integrated into the DoD's Explosives Safety Siting (ESS) Software program in 2018/2019

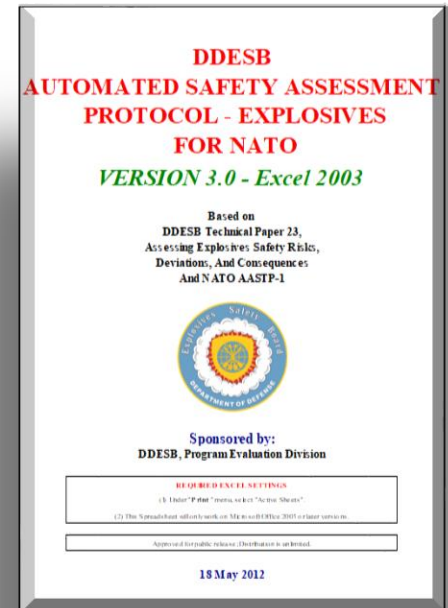
	U.S.		
Zone US = NATO	Facility Damage %	Fatality %	Injury %
1 (K6) = Q2.4	100%	100%	0%
2 (K9) = Q3.6	100%	90%	10%
3 (K11) = Q4.7	100%	80%	20%
4 (K18) = Q7.1	50%	20%	40%
5 (K24/30) = Q9.5/Q12	20%	2%	4%
6 (K40/50) = Q15.9/Q19.8	5%	1%	2%





# ESMRM Assessment Tools

- A NATO version of the tool “*NATO Automated Safety Assessment Protocol – Explosives (NASAP-X)*” is available.
  - NASAP-X tool analyzes potential risks based the distance between Potential Explosion Sites (PESs) (ECM, Open, Other) to Exposed Sites (ESs).
  - Analyzes consequences associated with overpressure and fragmentation based on Q-factors derived from Allied Ammunition Storage and Transportation Publication (AASTP-1), “*Manual of NATO Safety Principles for the Storage of Military Ammunition and Explosives.*”

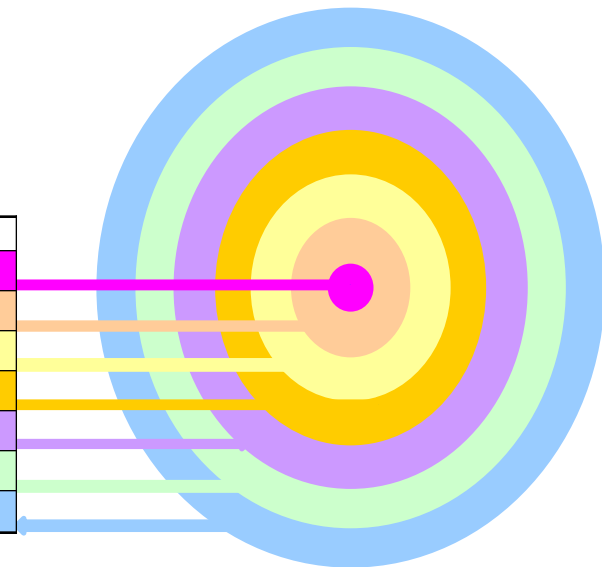




# ESMRM Assessment Tools

- *NATO Automated Safety Assessment Protocol - Explosives (NASAP-X)*  
(Cont.)
  - Estimates the potential number of fatalities and infrastructure damage (not injuries)
  - The NASAP-X tool doesn't take into consideration the probability of event nor PES orientation when calculating risks
  - Excel spreadsheet based

Zone NATO = US	NATO	
	Facility Damage %	Fatality %
1 (Q2.4) = K6	100%	100%
2 (Q3.6) = K9	100%	91%
3 (Q7.2) = K18	50%	21%
4 (Q9.6) = K24	20%	3%
5 (Q14.8/PTRD) = K37	10%	2%
6 (Q22.2/IBD) = K56	5%	1%
7 (Q44.4/2IBD) = K112	1%	1%





# Munitions Risk Assessment System (MRAS)

- The C&RI Tool is currently automated within the MRAS

Trimble Yuma-2 GPS/GIS enabled tablets



## Automated Output Data

Exposure	Distance	Personnel	Fatality	Building Cost (\$)	Building
Personnel	0-1000	1000	1	1000000	1000000
Personnel	1000-2000	500	0.5	500000	500000
Personnel	2000-3000	300	0.3	300000	300000
Personnel	3000-4000	200	0.2	200000	200000
Personnel	4000-5000	150	0.15	150000	150000
Personnel	5000-6000	100	0.1	100000	100000
Personnel	6000-7000	75	0.075	75000	75000
Personnel	7000-8000	60	0.06	60000	60000
Personnel	8000-9000	50	0.05	50000	50000
Personnel	9000-10000	40	0.04	40000	40000
Personnel	10000+	30	0.03	30000	30000
Personnel	Total	1000	1	1000000	1000000
Buildings	0-1000	1000	1	1000000	1000000
Buildings	1000-2000	500	0.5	500000	500000
Buildings	2000-3000	300	0.3	300000	300000
Buildings	3000-4000	200	0.2	200000	200000
Buildings	4000-5000	150	0.15	150000	150000
Buildings	5000-6000	100	0.1	100000	100000
Buildings	6000-7000	75	0.075	75000	75000
Buildings	7000-8000	60	0.06	60000	60000
Buildings	8000-9000	50	0.05	50000	50000
Buildings	9000-10000	40	0.04	40000	40000
Buildings	10000+	30	0.03	30000	30000
Buildings	Total	1000	1	1000000	1000000
Total	Total	2000	2	2000000	2000000



Site	Exposure Location	Exposures		Potential Consequences	
		Personnel Within IBO	Infrastructure Cost	Fatalities <sup>1</sup>	Infrastructure Damage Loss <sup>2</sup>
	On-Base				
	Off-Base				
	TOTAL				

<sup>1</sup> The potential fatalities and building damage loss were determined using the C&RI Assessment Tool that analyzes an exposed site's estimated population and property (i.e., assets, facilities, and infrastructure within the ESCO IBO w/c) based on the functional use, size, and cost per square foot. This tool provides the estimated number of fatalities and property replacement value based on potential damage resulting from the exposed site's physical distance to the PES.

<sup>2</sup> Construction Cost reference.



# Munitions Risk Assessment System (MRAS)

## Pre-assessment planning products:

- ArcGIS area Maps & Construction Cost
- Integrated Shape file overlays (i.e. Installation boundaries, ESQD arcs, Groupings, etc...)

Load ArcGIS & Construction Cost Data on devices

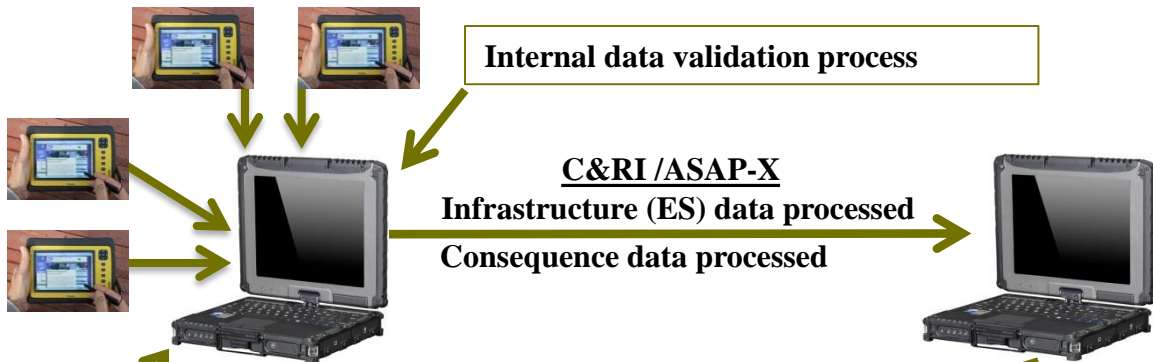


## Conduct Field Assessment

- Validate ArcGIS data
  - Add/Remove Facilities
- Collect & validate ES data
- Collect GPS data (PES/ES)
- Collect images



Upload field data



Internal data validation process

C&RI /ASAP-X

Infrastructure (ES) data processed  
Consequence data processed

Report / Output Data

### Infrastructure ES - Output Data

- Tabular data
  - Exposed personnel
  - Infrastructure by type data
  - Infrastructure cost data
  - Location GPS Data
- Summary tabular data
- Exposure data (personnel & infrastructure cost data)
- Image data
  - Base boundary & IBD arc
  - Grouping data

### Consequence - Output Data

- Consequences summary:
  - Infrastructure damage est.
  - Personnel fatality & injury est.
- Color-coded tabular ES Output data by zone:
  - On-base by zone
  - Off-base by zone
  - Total by zone
- Total Exposures & consequences
- Fact sheet
- Image data



# Munitions Risk Assessment System Example

- Pre-planning

- Define scope of operation?

- ✓ Location of potential explosion site (PES)
  - Small boat pier at Naval Mine and Anti-Submarine Warfare Center, Point Loma Naval Base

- Small boat pier at Naval Mine and Anti-Submarine Warfare Center, Point Loma Naval Base

- ✓ Define operation:

- 500 lbs. Net Explosives Weight (NEW) munitions transfer

- Enter PES information in C&RI/ASAP-X tool on the Input Worksheet

POTENTIAL EXPLOSIVE SITE (PES)		PES GPS COORDINATES								HAZARD DIVISION	NEW (LBS)	
		GPS WAY-POINT	LATITUDE				LONGITUDE				1.1	500
			DIR	DEG	MIN	SEC	DIR	DEG	MIN	SEC	1.2.1	
PES Name:	Point Loma	1	North	32	43	30.53	West	117	12	56.38	1.2.1 MCE	
Is the PES an open pad, ECM, or Other?	Other	2	North	32	43	27.22	West	117	12	57.54	1.2.2	
If an ECM, is it 26 ft x 60 ft or larger and a loading density less than 0.028 lbs/cubic ft?		3	North	32	43	27.36	West	117	12	58.03	1.2.3	
If an ECM, is it Undefined?		4	North	32	43	30.68	West	117	12	56.91	1.2.3 MCE	
If Other, can it stop primary fragments?	No	GPS Unit# :								1.2.3 HFD (xx)		



# Munitions Risk Assessment System Example

2. This will populate Zone distances in the Output Page of the C&RI tool

Distance	ZONE	FATAL	BUILDING DAMAGE LOSS	INJURIES	% FATAL	% BLDG DAMAGE	% INJURIES
48	1 (K6)						
71	2 (K9)						
87	3 (K11)						
143	4 (K18)						
750	5 (K24/PTRD)						
1,250	6 (K40/IBD)						
TOTAL PEOPLE AFFECTED							
TOTAL FATALITIES							
% FATALITIES							
TOTAL INJURIES							
% INJURIES							
TOTAL BUILDING COSTS							
TOTAL BLDG DAMAGE LOSS							
% BUILDING DAMAGE LOSS							
TOTAL ESs AFFECTED							

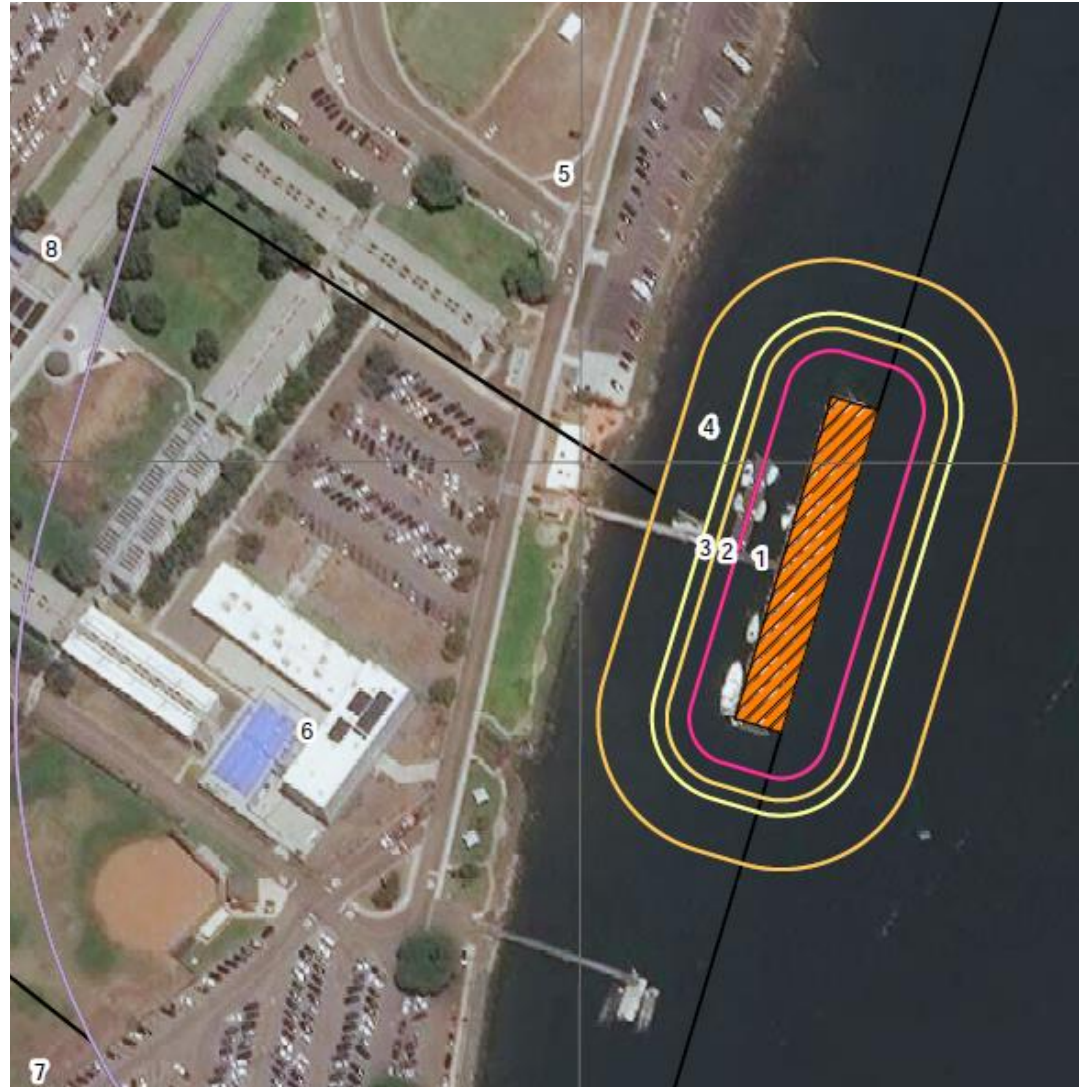
Note: Same data can be pulled from any DDESB approved Quantity Distance Calculator

3. Download high quality image that is rectified/georeferenced from sites like Digital Globe™
4. Use program like ArcGIS™ to draw shape files representing:
  - 1) The PES
  - 2) Each of the ESQD zones (1 through 6)
  - 3) Groupings within the ESQD arcs



# Munitions Risk Assessment System Example

- Groupings should not cross ESQD zones
  - 1) Try to Group like facilities
  - 2) Grouping help ensure complete area coverage when multiple team are collecting data
  - 3) Groupings reduce overall data entry requirements and are particularly helpful in densely populated areas



**Fictitious Example - ESMRM Assessment to conduct munitions on-load operations**

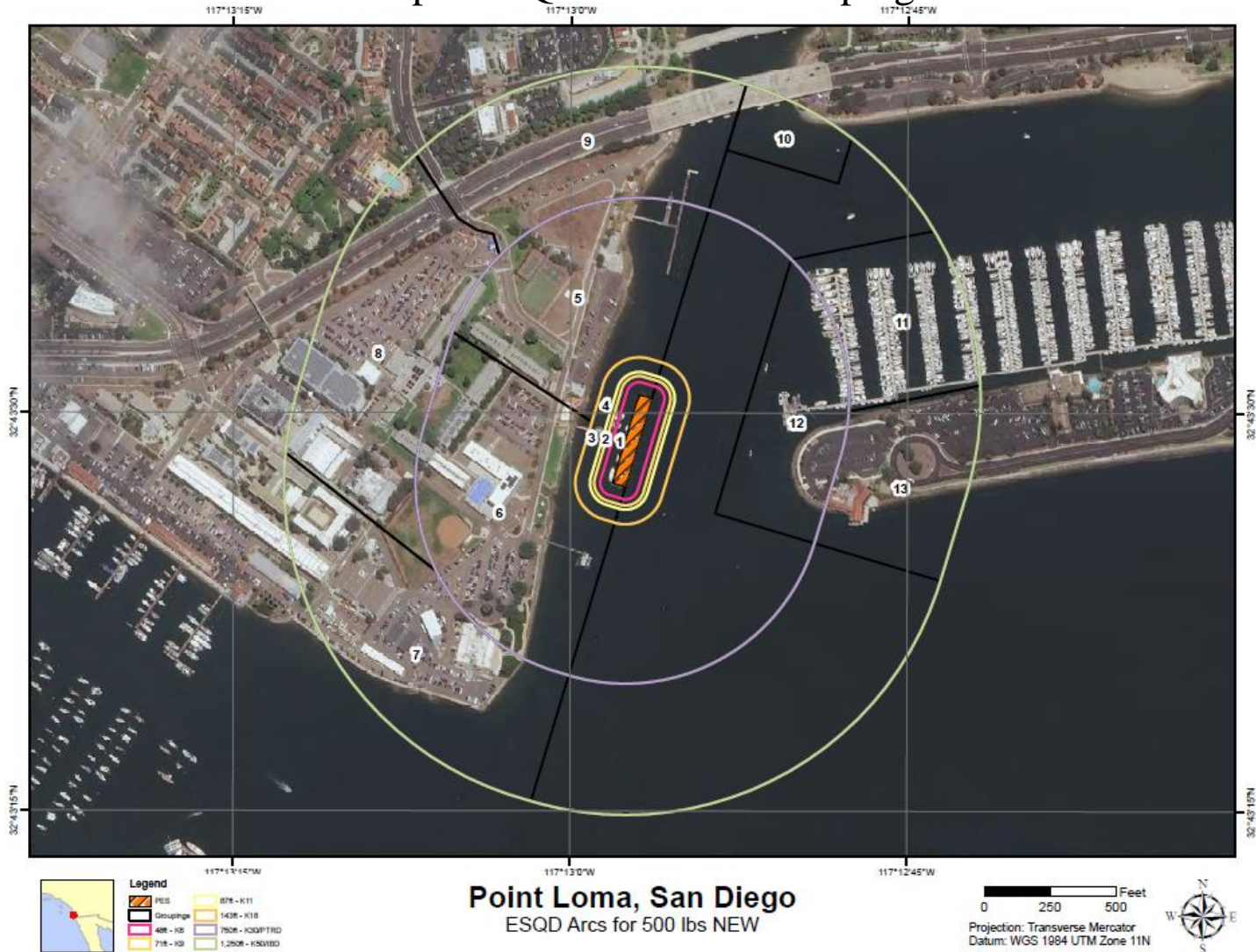
1. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB





# Munitions Risk Assessment System Example

## Example ESQD Arcs and Groupings



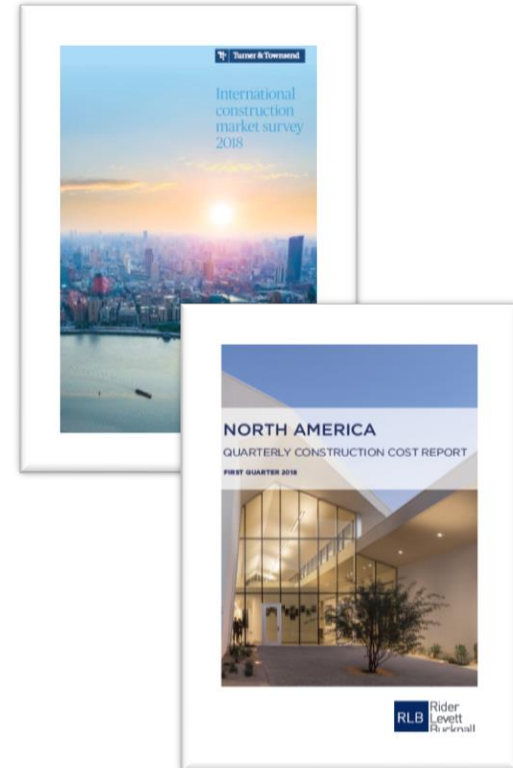
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# Munitions Risk Assessment System Example

## 5. Load infrastructure cost data into MRAS

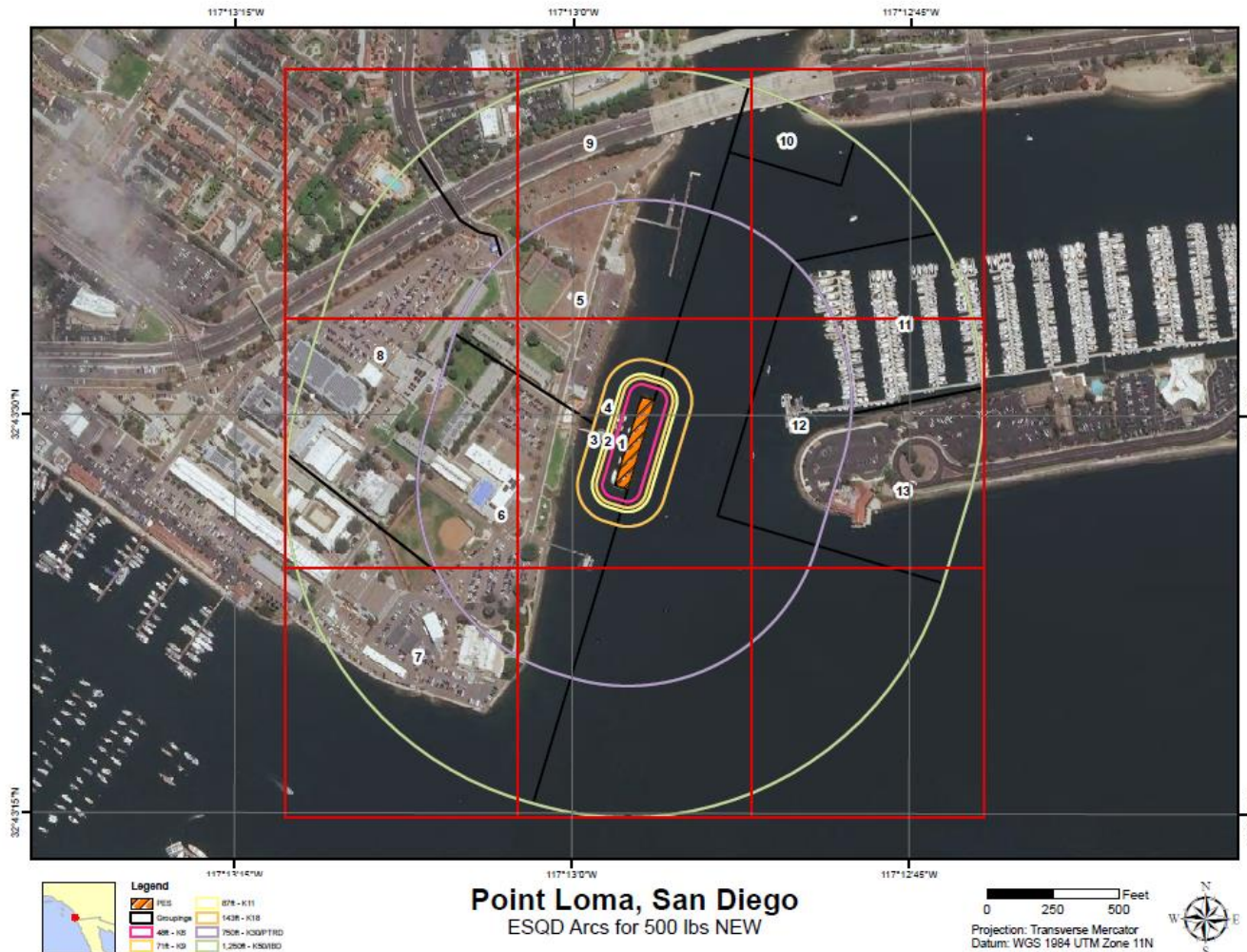
- Construction costs are used to calculate infrastructure value and damage estimates exposures – Cost per Square Foot
- Six Infrastructure exposures types are used in the C&RI tool
  - ✓ **Residential** properties include single detached homes, apartments, duplex, and condominiums -- \$337.50
  - ✓ **Commercial** properties include office buildings, banks, retail outlets, malls, hotel, resorts, etc. -- \$266.00
  - ✓ **Industrial** properties include factories, repair/machine shops, manufacturing facilities, refineries, warehouses, etc. -- \$165.00
  - ✓ **Institutional** properties include schools, post office, stadiums, hospitals, government facilities, etc. -- \$550.00
  - ✓ **Agricultural** properties include farms, feedlots, ranches, slaughter houses, etc. – N/A
  - ✓ **Other** to capture miscellaneous infrastructure & equipment (e.g., large gantry type cranes at ports) -- Various





# Munitions Risk Assessment System Example

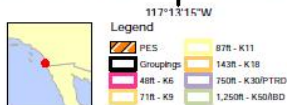
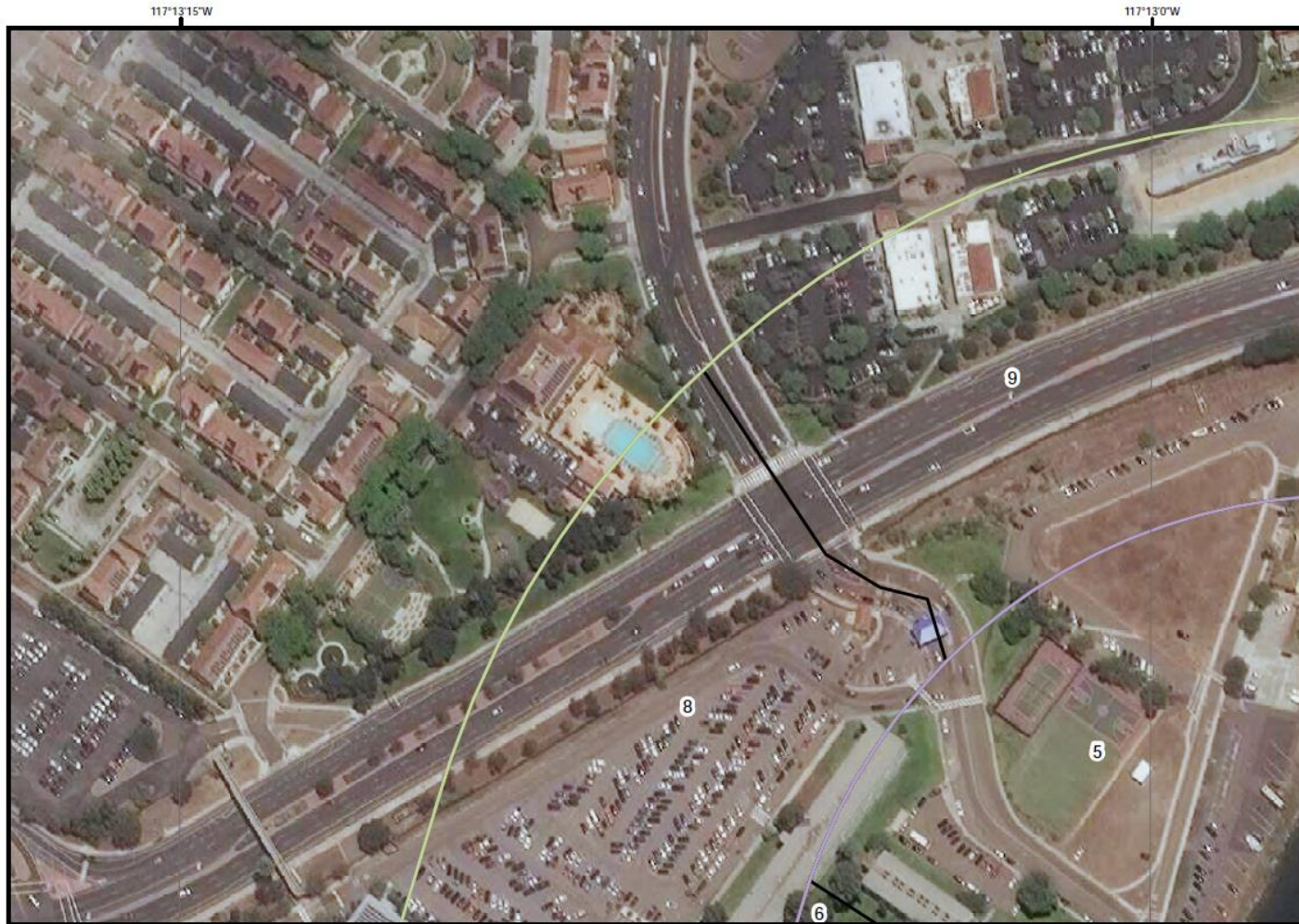
- Further sub-divide maps into grids to provide backup map for assessment teams



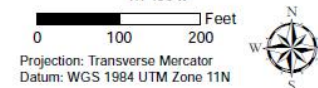
1. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# Munitions Risk Assessment System Example



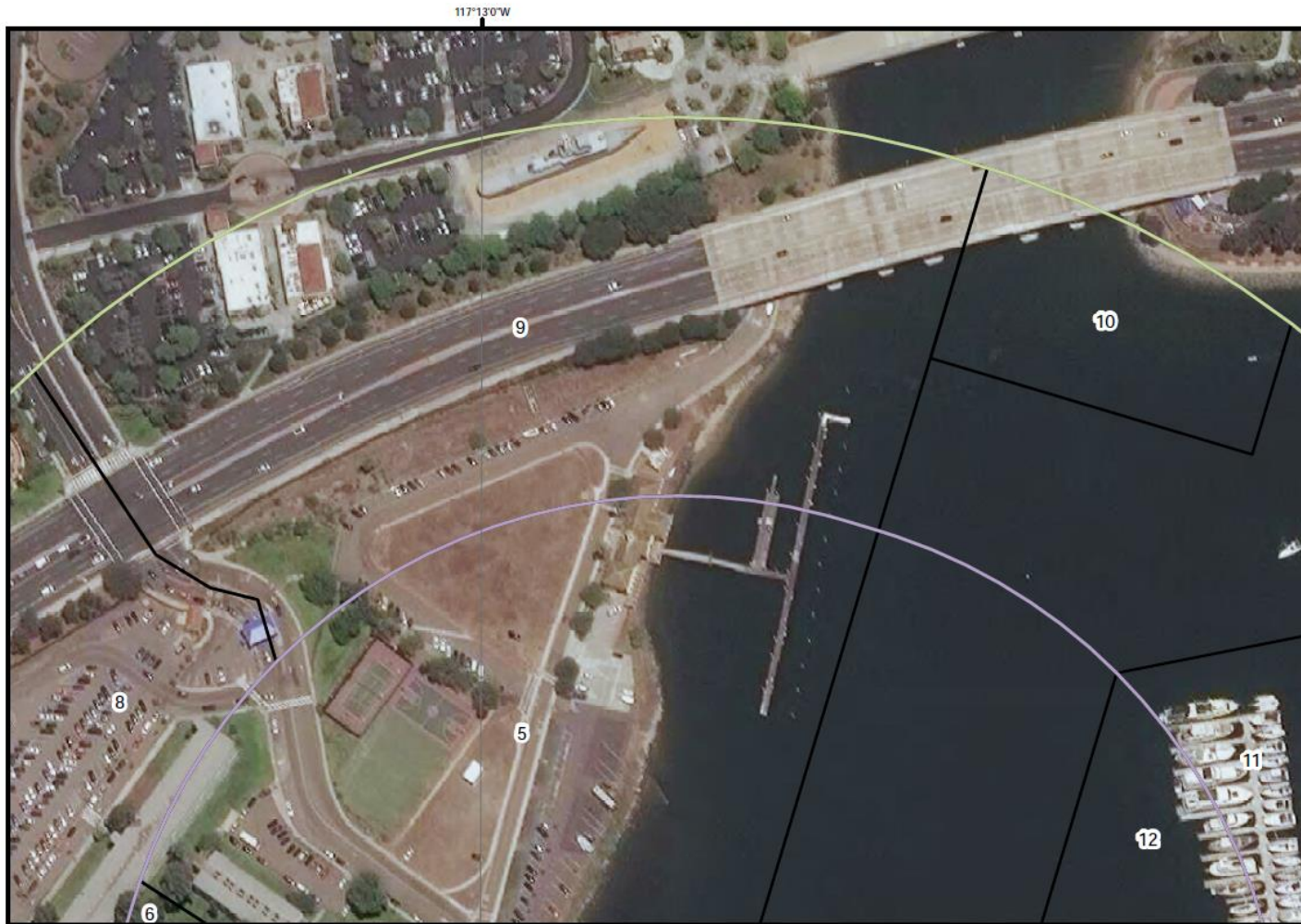
Point Loma, San Diego  
ESQD Arcs for 500 lbs NEW



1. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



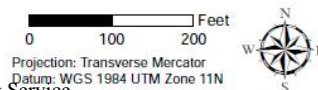
# Munitions Risk Assessment System Example



**Legend**

	PES		87R - K11
	Groupings		143R - K18
	48R - K6		750R - K30P/PTRD
	71R - K9		1,250R - K30P/PTRD

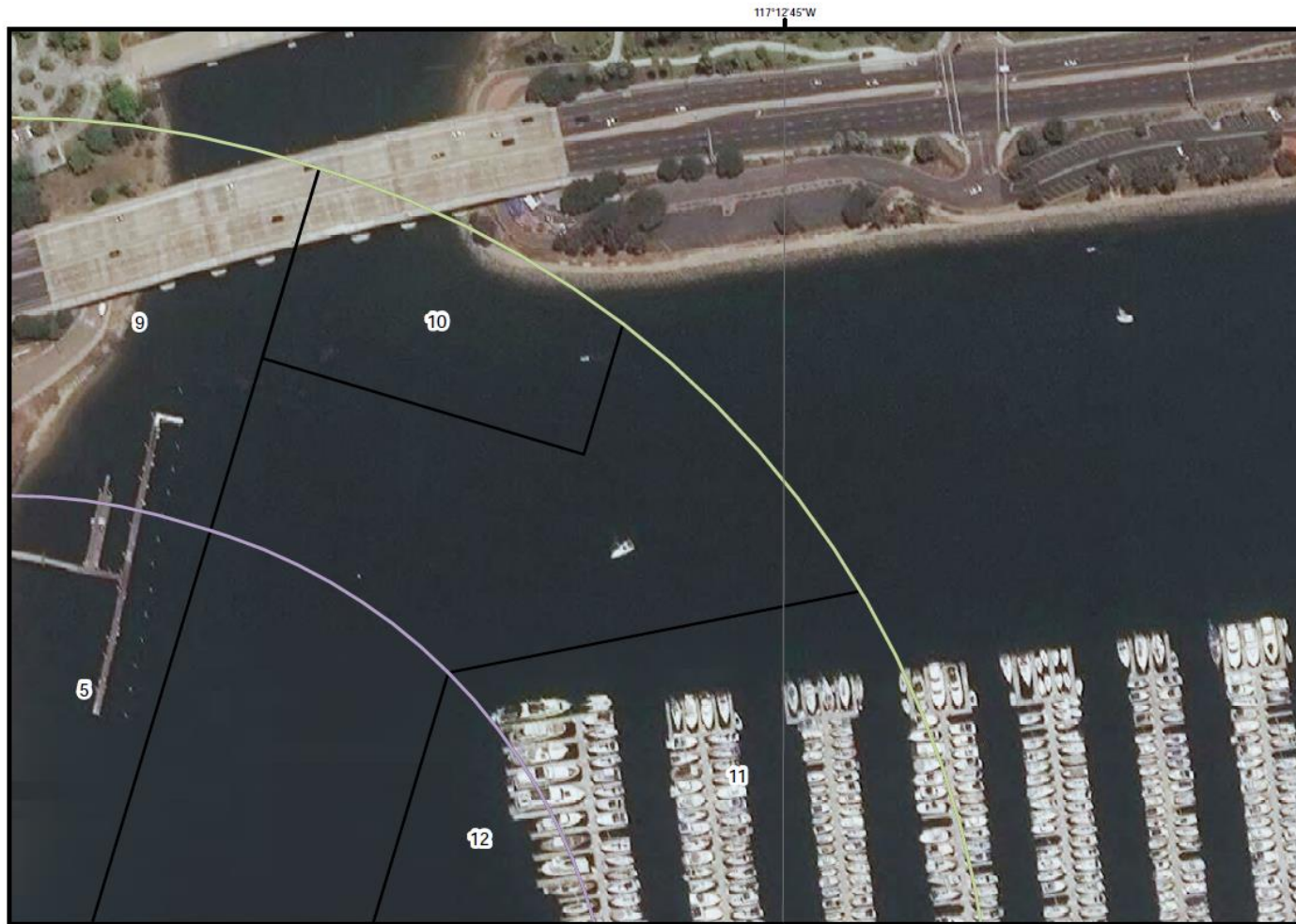
Point Loma, San Diego  
ESQD Arcs for 500 lbs NEW



T. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service.  
2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# Munitions Risk Assessment System Example



Legend	
	PELS
	Groupings
	48R - K6
	71R - K9
	87R - K11
	143R - K18
	750R - K30/PTRD
	1,250R - K50/BD

Point Loma, San Diego  
ESQD Arcs for 500 lbs NEW

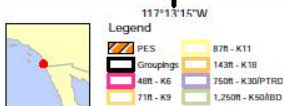
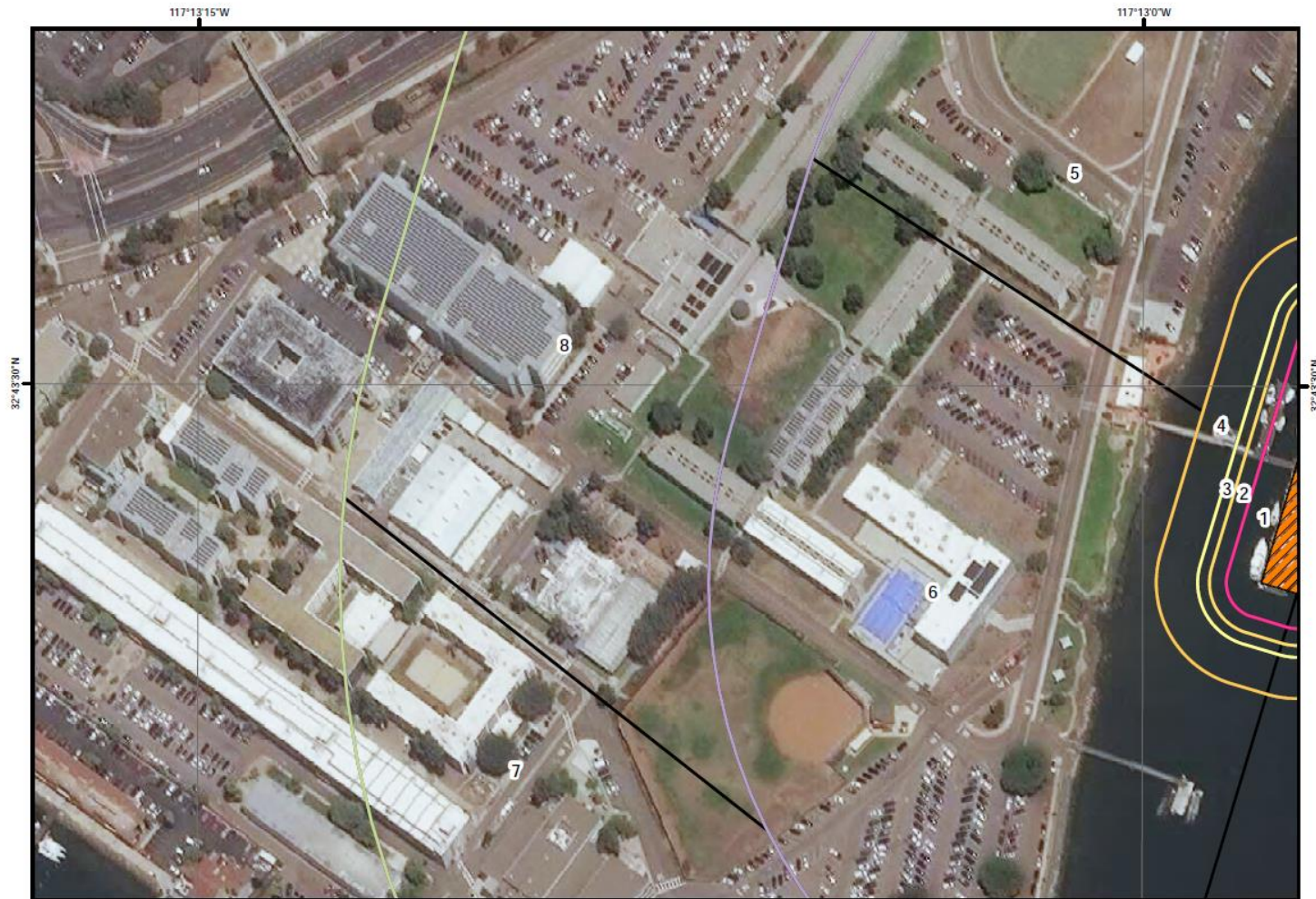
0 100 200 Feet  
Projection: Transverse Mercator  
Datum: WGS 1984 UTM Zone 11N



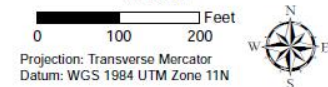
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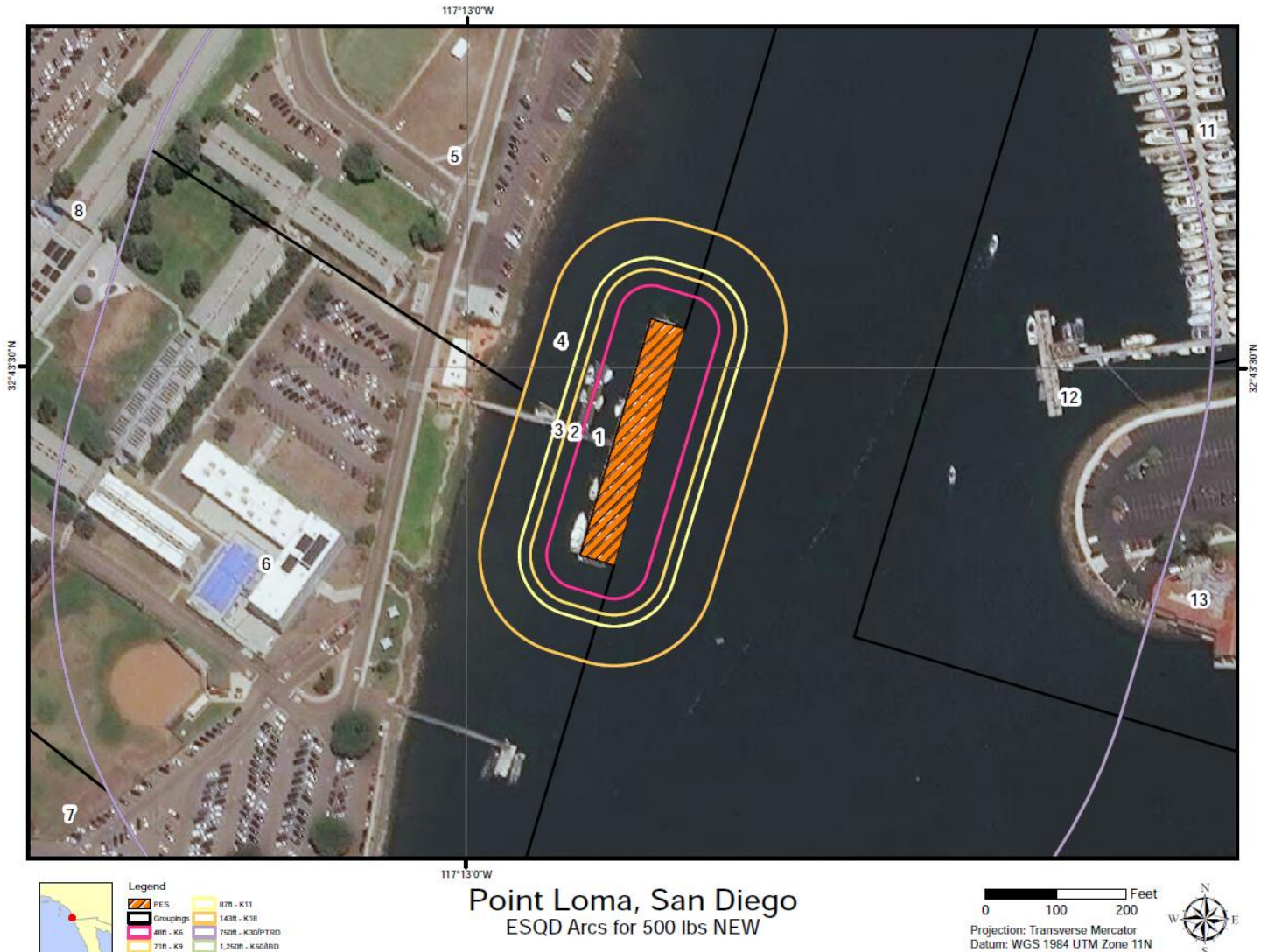
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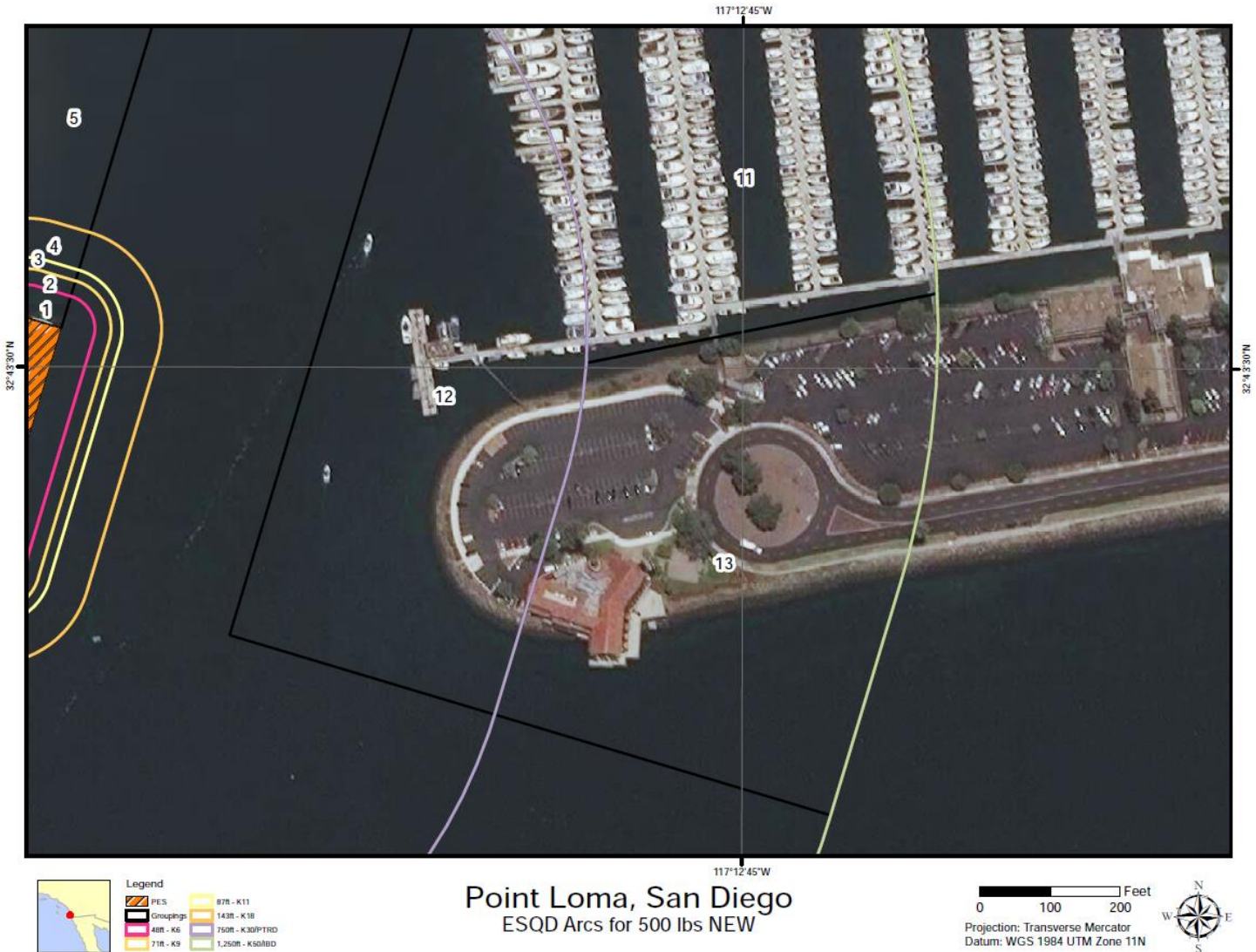


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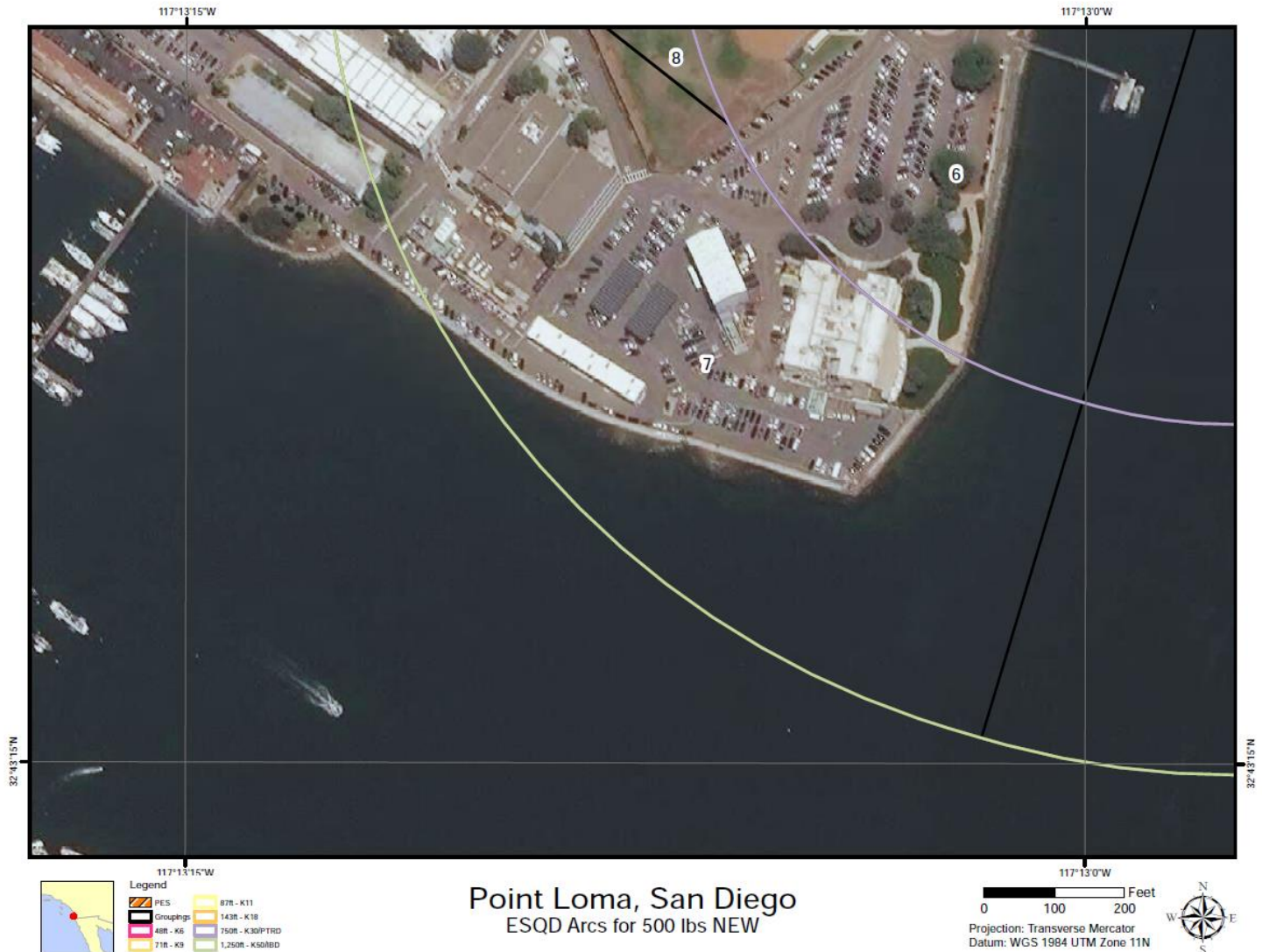
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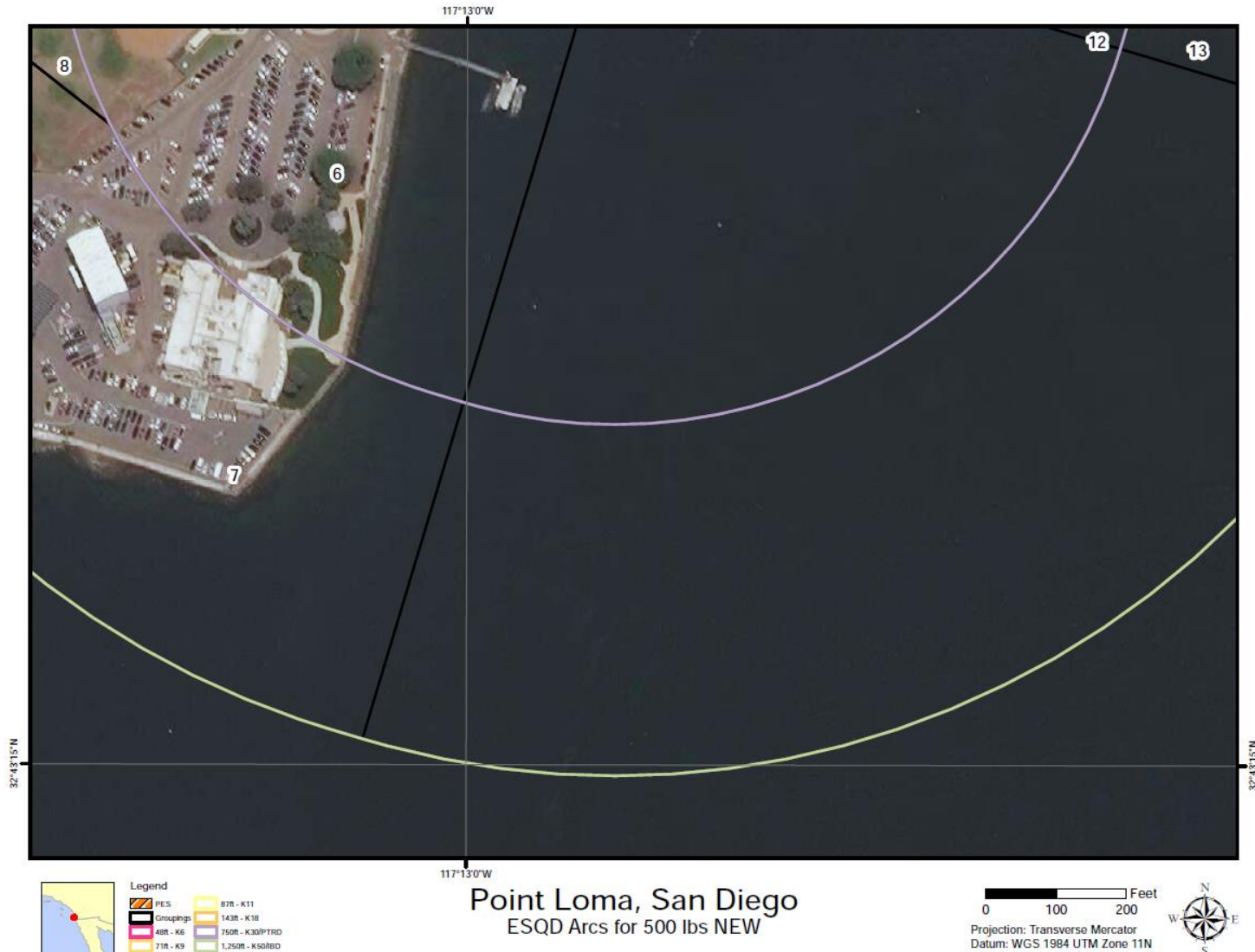
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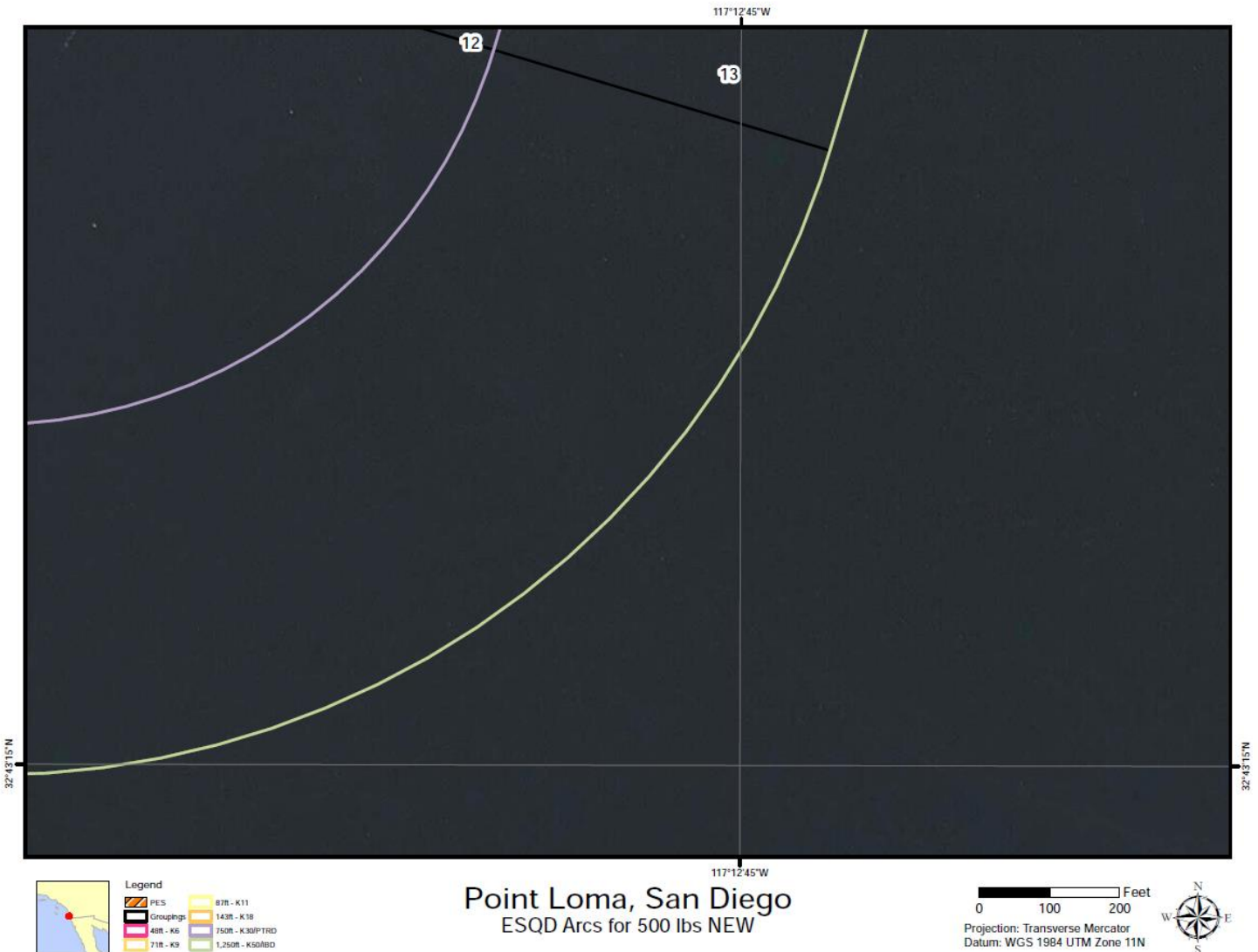
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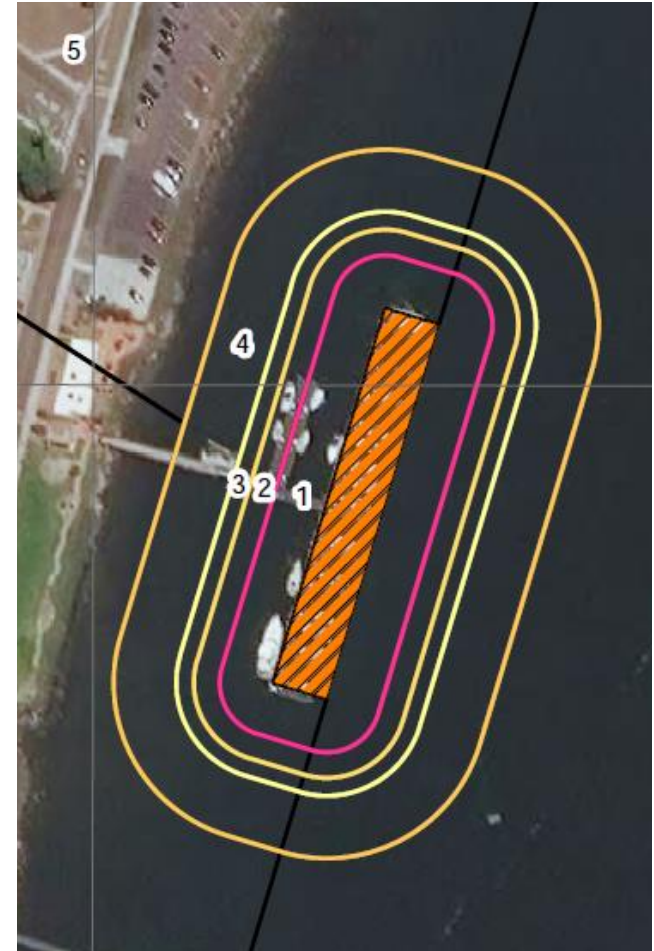


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# Munitions Risk Assessment System Example

- Conducting the On-site ESMRM Assessment
  - Steps 1-4 of the ESMRM Assessment process: Initiation, Scope Development, Pre-Coord/Info gathering and Pre-Assessment Analysis are completed
  - On-site Assessment goals include:
    - ✓ Validate mission scope and pre-planning assumptions
    - ✓ Identifying risks to and from munitions at and around the PES
      - Facilities/equipment/capabilities to support operations, lightning protection, hazardous materials etc...
      - Each assessment is unique and having experienced explosives safety personnel and personnel familiar with the proposed operating location is critical



1. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# Munitions Risk Assessment System Example

- Collecting ES infrastructure data within ESQD arcs
  - Teams collect infrastructure and personnel exposure data within assigned grouping



1. Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# Munitions Risk Assessment System Example

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- Collecting ES infrastructure data within ESQD arcs (continued)
  - The most accurate method is to physically measure each facility
  - Measurements can also be taken from imagery when conducting desktop assessments provided the images are scaled. (Determining the number of stories is very challenging)
  - Large numbers of buildings makes physically measuring each building impractical
    - ✓ When estimating building sizes the use of “Equivalent Units” helps to scope the issue
    - ✓ Equivalent Units are pre-defined square footage sizes that can be used to quickly estimate a buildings size
    - ✓ As an example a 40’ x 40’ building is 1600 square feet. When looking at a building simply estimating how many 40’ x 40’ cubes can fit in the building can be used to estimate the total square footage
    - ✓ Counting the number of equivalent units, of each property type, in an assessment grouping is an acceptable method for estimating property exposures
- Infrastructure Data collected within each group is characterized based on the facility type (Industrial, commercial, instructional, residential, agricultural, and other)



# Munitions Risk Assessment System Example

- Determining personnel exposures
  - There are a number of ways to estimate the populations in a given area
    - ✓ Census can be used as a means to help validate data collection efforts
    - ✓ Occupancy placards
    - ✓ Asking local government officials
    - ✓ Asking owners/supervisors at commercial, industrial and government facilities
    - ✓ Estimating the number of personnel in various types of properties
    - ✓ A combination of methods is often used in an assessment
  - Establishing general guidelines for each of the data collection teams helps to maintain data consistency (i.e., the average number of personnel per residence is 3)

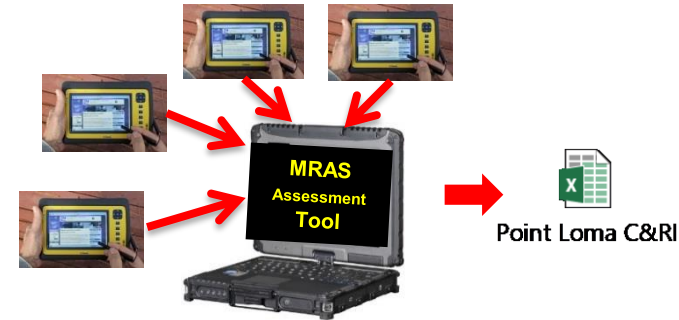
TEAM #: _____		ES GROUP #: _____	
Property Types:		<b>COM</b> mmercial, <b>RES</b> idential, <b>IND</b> ustrial, <b>INST</b> itutional, <b>AGR</b> icultural, <b>OTHer</b>	
Equivalent Unit Size:		_____ ft <sup>2</sup>	
Personnel Per Unit:		_____ ( <i>unless otherwise noted</i> )	
PROPERTY TYPE	EQUIVALENT UNITS	TOTAL PERSONNEL	NOTES





# Munitions Risk Assessment System Example

- Analyzing potential Risk
  - Exposed infrastructure and personnel census data is entered into the ASAP-X/C&RI Excel Spreadsheet or into the MRAS
  - Potential consequences are analyzed based on the Net Explosives Weight (NEW) at the Potential Explosion Site (PES) and the distances to the exposed sites(ESs)



## OUTPUT DATA FOR

ZONE	DISTANCE	FATAL	BUILDING DAMAGE LOSS	% FATAL	% BLDG DAMAGE	Total # Personnel	INJURIES	Injury Report
1	1 (K6)	3	660,000	100%	100%	3	0	All non-fatal are injuries
2	2 (K9)	3	660,000	100%	100%	3	0	All non-fatal are injuries
3	3 (K11)	3	660,000	100%	100%	3	0	All non-fatal are injuries
4	4 (K18)	2	508,866	67%	77%	3	1	Sliding scale from "all non-fatal" to 2X fatalities
5	5 (K24/PTRD)	92	65,046,656	10%	33%	952	184	Twice the # of fatalities
6	6 (K40/IBD)	30	47,727,359	2%	14%	1,905	60	Twice the # of fatalities
Total Fatalities		133	Total # Personnel		2,869	Total Injuries		245

- Potential consequences spreadsheet:





# Munitions Risk Assessment System Example

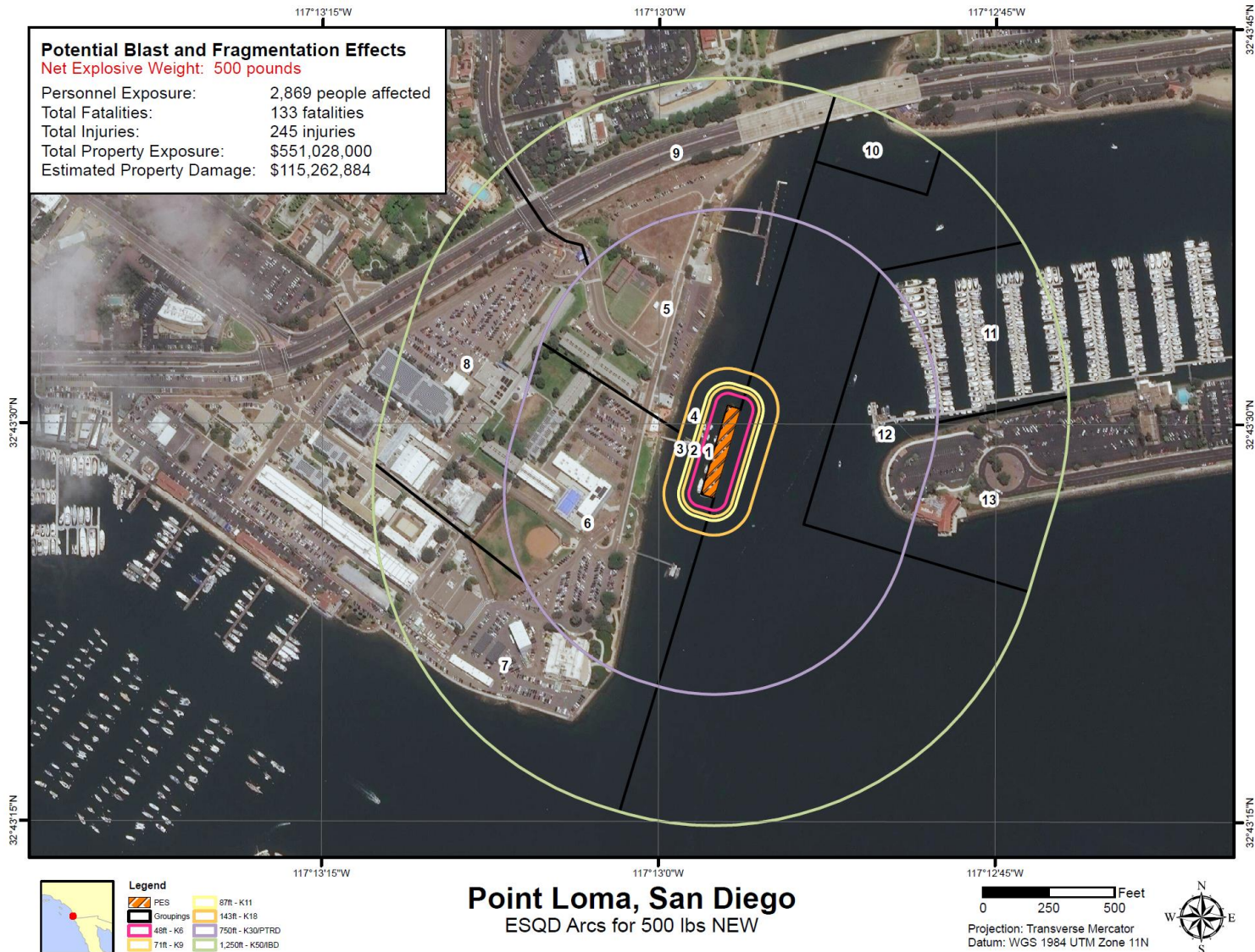
## ■ Risk Analysis

- Hazard Severity and Probability - Based on the analysis determine the overall risks to and from munitions related processes
- Military Standard 882E, “*Department of Defense Standard Practice System Safety,*” or the Services’ Safety process can be used to quantify the potential risks.

Description	Severity Category	Mishap Result Criteria					
<b>Catastrophic</b>	<b>1</b>	<b>Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or monetary loss equal to or exceeding \$10 million (M).</b>					
Critical	2	Could result in one or more illness that may result in hospitalization, permanent disability, or significant environmental impact, or more than one lost work day(s), reversible \$100 thousand (K) but less than \$1 million (M).	<b>Probability</b>	<b>Severity</b>			
Marginal	3			Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Negligible	4	Could result in one or more lost work day, minimal environmental impact, or more than one lost work day(s), reversible \$100 thousand (K) but less than \$1 million (M).	Frequent (A)	High	High	Serious	Medium
			Probable (B)	High	High	Serious	Medium
Remote	D	Unlikely but possible to occur in the life of an item.	Occasional (C)	High	Serious	Medium	Low
			Remote (D)	Serious	Medium	Medium	Low
Improbable	E	So unlikely it can be assumed occurrence may not be experienced in the life of an item.	Improbable (E)	Medium	Medium	Medium	Low
Eliminated	F	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.	Eliminated (F)	Eliminated			
Remote	D	Unlikely but possible to occur in the life of an item.	Unlikely but can be reasonably expected to occur.				
Improbable	E	So unlikely it can be assumed occurrence may not be experienced in the life of an item.	Unlikely to occur, but possible.				
Eliminated	F	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.	Incapable of occurrence. This level is used when potential hazards are identified and later eliminated.				



# Munitions Risk Assessment System Example





# Munitions Risk Assessment System Example

- Risk Control Plan
  - Develop site specific Risk Reduction Recommendations
  - Develop Corrective Action Plans as appropriate

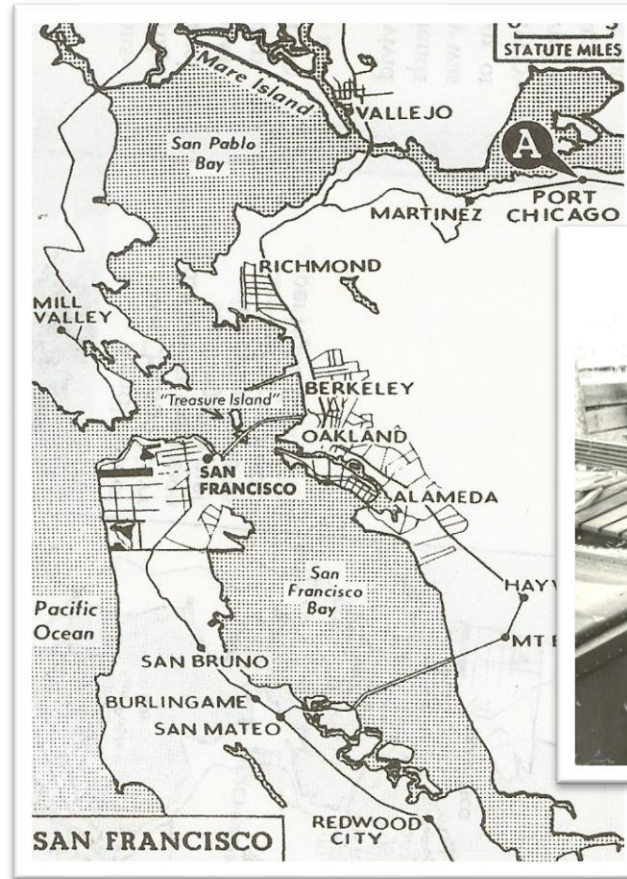
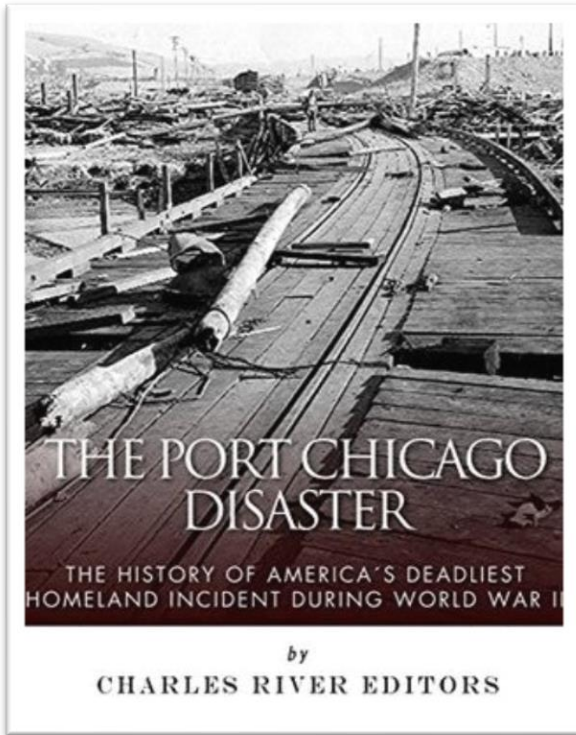
## PORT/PIER FACT SHEET: Point Loma MITIGATING CONTROL MEASURES

**Instructions: These control measures are provided for your use. Modify as needed for this specific site; use the blank space to add any site-specific measures.**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> Require the host nation to provide firefighting support.</li> <li><input type="checkbox"/> Generate a fire map that identifies the HD of all military munitions located at the site and provide it for first responders.</li> <li><input type="checkbox"/> Provide medical support during all on/offloading operations.</li> <li><input type="checkbox"/> Provide access to and maintain standard operating procedures during all on/offloading operations.</li> <li><input type="checkbox"/> Provide the appropriate level of security that is required for the security risk codes of military munitions during on/offloading.</li> <li><input type="checkbox"/> Arrange for explosive ordnance disposal support during on/offloading operations.</li> <li><input type="checkbox"/> Require a safety loading officer is present during all military munitions on/offloading operations.</li> <li><input type="checkbox"/> Establish applicable emergency withdrawal distances based on the highest HD of military munitions being on/offloaded and brief all personnel working on the pier.</li> <li><input type="checkbox"/> Establish notification procedures for impending electrical storms within 15 miles of the pier facility. Evacuate personnel to a minimum public traffic route distance based on the highest HD of military munitions being on/offloaded from the vessel.</li> <li><input type="checkbox"/> Require all vehicles and equipment offered for transporting military munitions are inspected by personnel who are AMMO-51 certified. On a case-by-case basis, the senior qualified inspector onsite will make a determination to use any vehicle or equipment that does not meet U.S. safety standards identified on DD Form 626, "Motor Vehicle Inspection (Transporting Hazardous Materials)."</li> <li><input type="checkbox"/> Enforce hazards of electromagnetic radiation to ordnance (HERO) restrictions to include radios, cell phones, and electronic devices. Set HERO conditions by the vessel.</li> </ul> | <ul style="list-style-type: none"> <li><input type="checkbox"/> Require that only qualified/certified personnel handle military munitions with the exception of host nation contracted crane operators and associated stevedores who are responsible for on/offloading explosives-laden International Organization for Standardization (ISO) containers.</li> <li><input type="checkbox"/> During military munitions on/offloading operations, have adjacent berths within established ESQD arcs clear of other vessels.</li> <li><input type="checkbox"/> Establish that material handling equipment, weight handling equipment, and ordnance handling equipment used to handle explosives-laden ISO containers have a current load test.</li> <li><input type="checkbox"/> Require a safety loading officer inspects the port/pier firefighting capabilities prior to on/offloading operations.</li> <li><input type="checkbox"/> Prohibit pier side ISO container break outs.</li> <li><input type="checkbox"/> Prohibit pier side overnight storage operations.</li> <li><input type="checkbox"/> Limit the number of personnel performing on/offloading operations to the minimum required to safely perform the operations.</li> <li><input type="checkbox"/> Obtain host nation concurrence and understanding of U.S. munitions activities and their potential impact on population exposure to the ESQD arc.</li> <li><input type="checkbox"/> Control and secure the port/pier and nearby waterfront area to prevent unauthorized persons from having access to these areas during munitions on/offloading operations.</li> <li><input type="checkbox"/> Coordinate and schedule munitions operations with nearby industrial, commercial, residential, and institutional facilities' occupants to reduce exposure risk to an acceptable level.</li> </ul> |
|---|--|



# Questions / Comments / Discussion



Source: Charles River. The Port Chicago Disaster: The History of America's Deadliest Homeland Security Incident During World War II. Charles River Editors, 2015

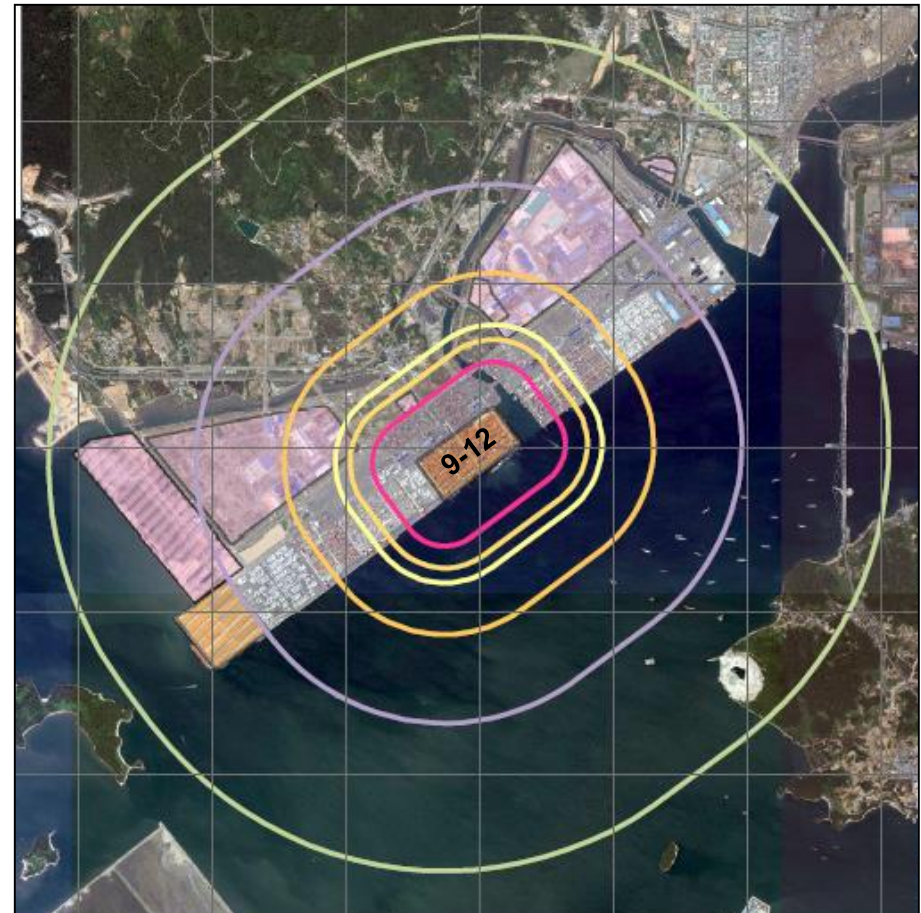
**Port Chicago, California Ship Explosion of 17 July 1944.** The explosion of about 3,500,000 pounds of explosives in railroad cars on the pier and in the holds of a ship resulted in the death of 320 people, injuries to 390, and property damage estimated to be \$13,000,000. This incident provided empirical data based on the damage relationships by types, magnitude, direction and distance from the pier are recorded in the report by description, charts, tables, maps and in many cases by the determination of a formula for the fitted curve for the amount of damage per locality.

Worst explosives incident of WWII



# ESMRM Assessment Example - Port

- Pre-planning
  - Define potential explosion site (PES)
  - Define operation:
    - ✓ US Army munitions off-load operations at SPOD
    - ✓ Maximum Net Explosives Weight (NEW) 12M lbs.
- Based on PES location & NEW, ESQD arcs reflect area encumbered by munitions operations that require analysis
- Pre-planning coordination identified additional planned port usage

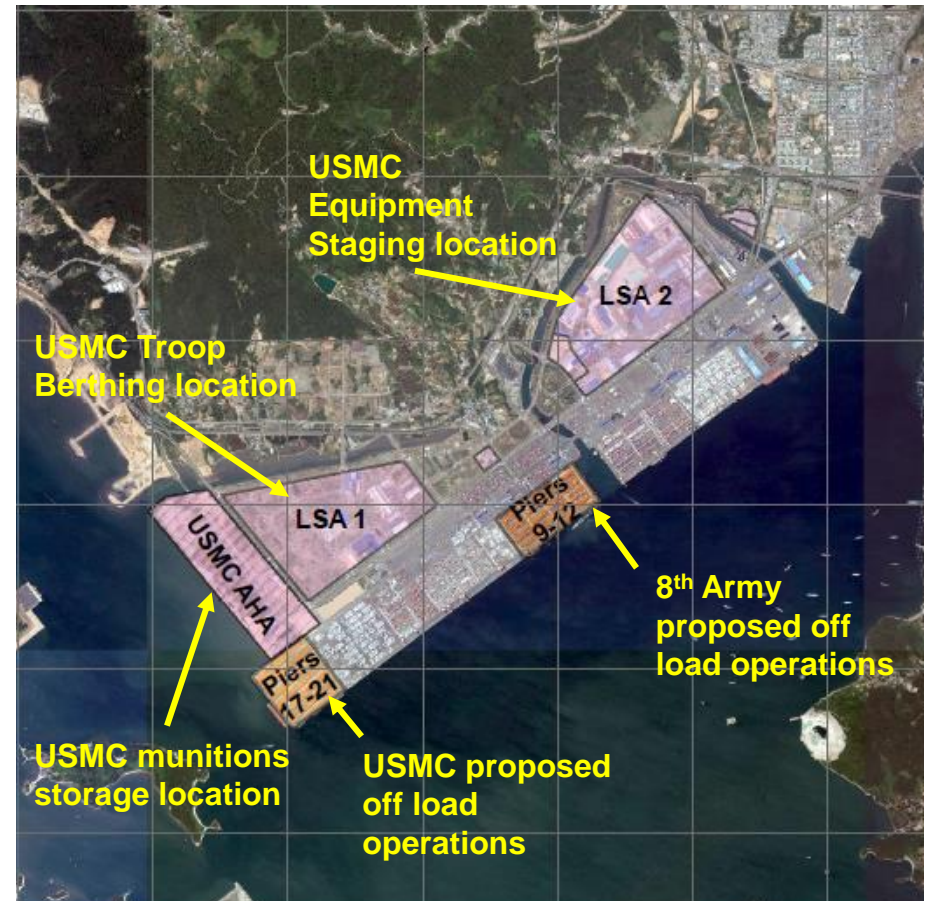


Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# ESMIRM Assessment Example - Port

- Pre-planning
  - USMC indicated that they were planning to use the port for:
    - ✓ Munitions on/off-load operations at piers 17-21 (7.6M NEW - Staging & Storage)
    - ✓ Ammunitions Holding Area (AHA)
    - ✓ Equipment laydown (LSA 2)
    - ✓ Troop berthing (LSA 1)
- Identification of Exposures
  - In addition to identifying potential risk to infrastructure and personnel the analysis team evaluated the potential risks to Army and USMC operations at the port

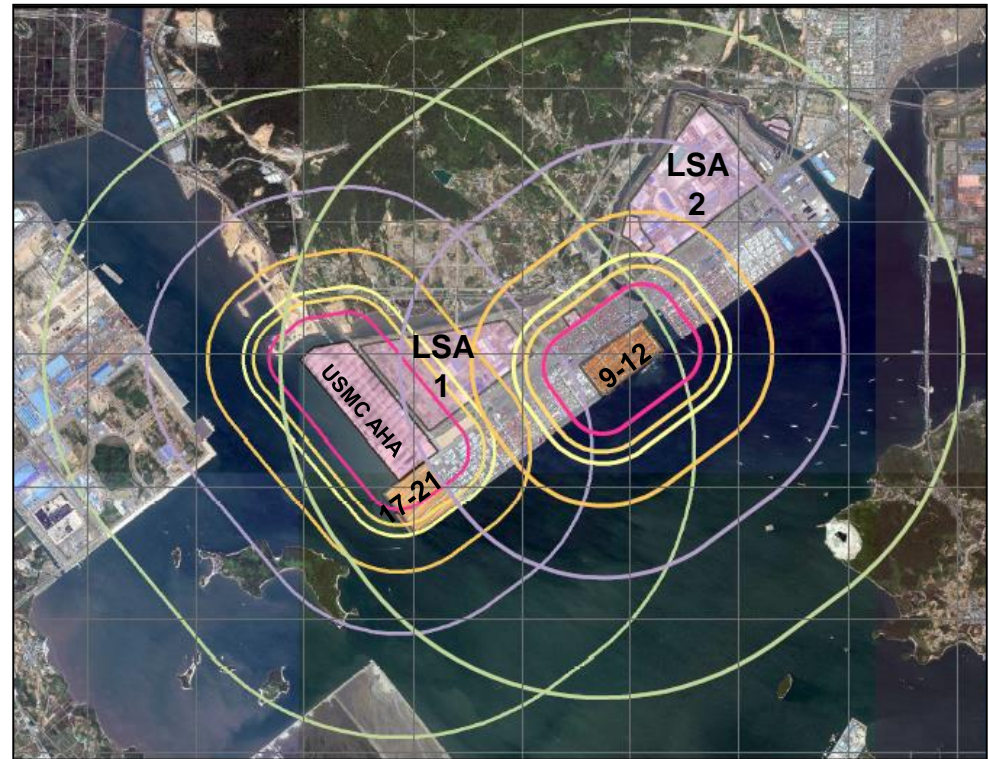


Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# ESMRM Assessment Example - Port

- Pre-planning analysis
  - The initial analysis showed that planning assumptions by Army & USMC created untenable risks:
    - ✓ Army operations at piers 9-12 would jeopardize USMC operations:
      - USMC equipment loss near 50%
      - USMC fatalities near 20%
    - ✓ USMC operations at piers 17-21 and at the AHA would jeopardize USMC and Army operations:
      - USMC fatalities near 80%
      - Risks to Army off-load operations



Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB





# ESMRM Assessment Example - Port

- Based on data collected during the pre-planning analysis:
  - USA/USMC agreed that the ESMRM Assessment Team would collect ESMRM data based on the areas encumbered by the composite ESQD arcs
  - Data collected during risk assessment would help identify Courses of Action (COAs)

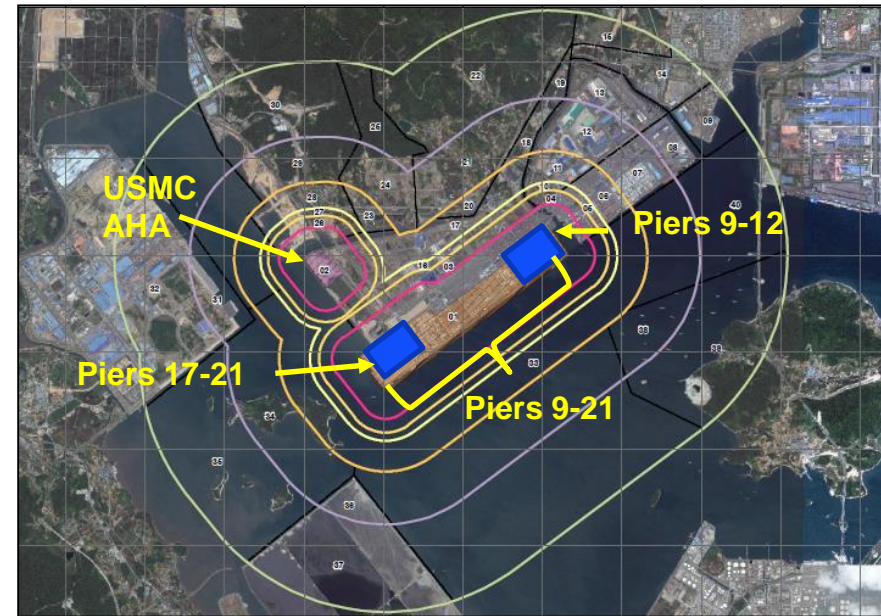


Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB



# ESMRM Assessment Example - Port

- Once exposure data was collected for encumbered areas
- The C&RI tool was used to analyze risks based on 4 different scenarios
- Risks were analyzed with C&RI tool to identify:
  - Potential infrastructure damage
  - Potential number of fatalities
  - Potential number of injuries



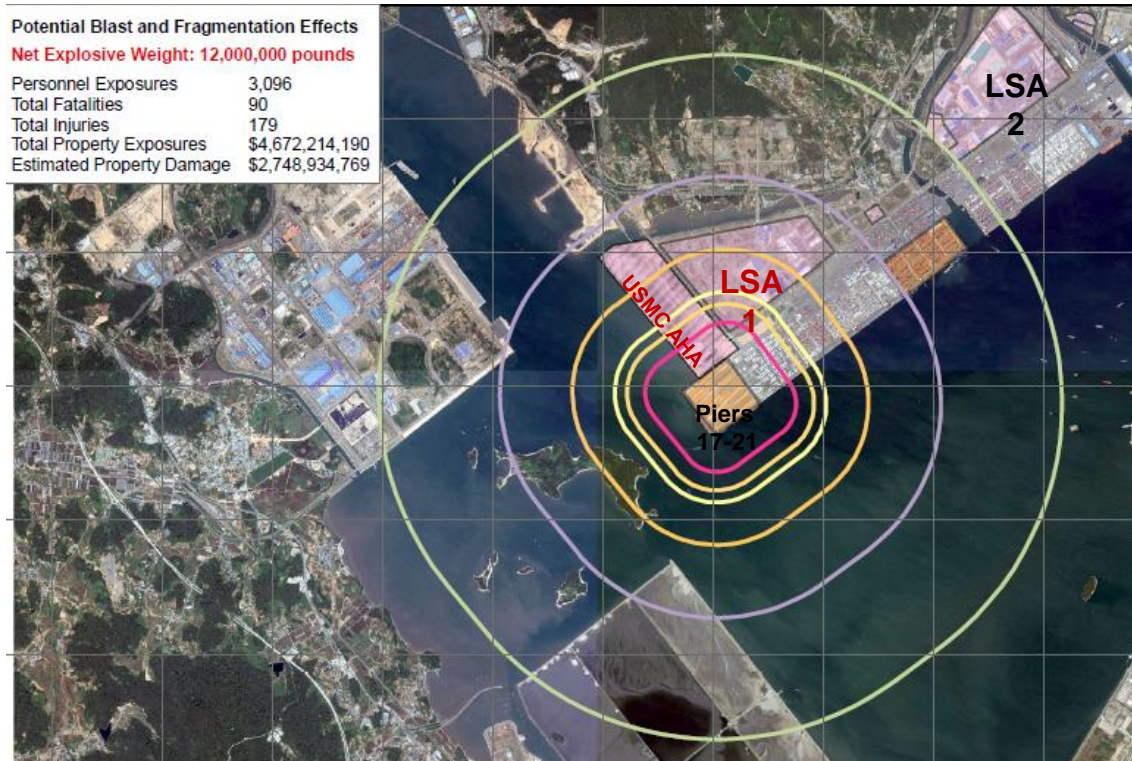
Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB

Potential Explosion Site	Exposures		Potential Consequences		
	Number of Personnel Within IBD	Infrastructure Cost (USD) <sup>2</sup>	Injuries	Fatalities <sup>1</sup>	Infrastructure Damage Loss (USD)*
USMC Ammunition Holding Area – 7.6M lbs. NEW	3,391	\$4,633,679,744	238	560	\$2,722,186,141
Utilization of Berths 9-12 – 12M lbs. NEW	11,004	\$5,798,984,291	590	848	\$2,600,841,986
Utilization of Berths 17-21 – 12M lbs. NEW	3,096	\$4,672,214,190	90	179	\$2,748,934,769
Utilization of Berths 9-21 – 12M lbs. NEW	12,905	\$7,185,333,011	800	1,098	\$4,616,870,466



# ESMRM Assessment Example - Port

- Base on risk analysis piers 17-21 posed the least amount of munitions-related risks
- USMC would not store munitions within pier complex in propose AHA
- USMC would not use Logistics Staging Areas (LSAs) - 1
- Army and USMC agreed to both conduct munitions operations at single location to minimize over all risk



Source: DigitalGlobe, Inc. National Geospatial-Intelligence Agency EnhancedView Web Hosting Service. 2014-2018. <https://evwhs.digitalglobe.com/myDigitalGlobe> (accessed 2017-2018). – Modified by DDESB