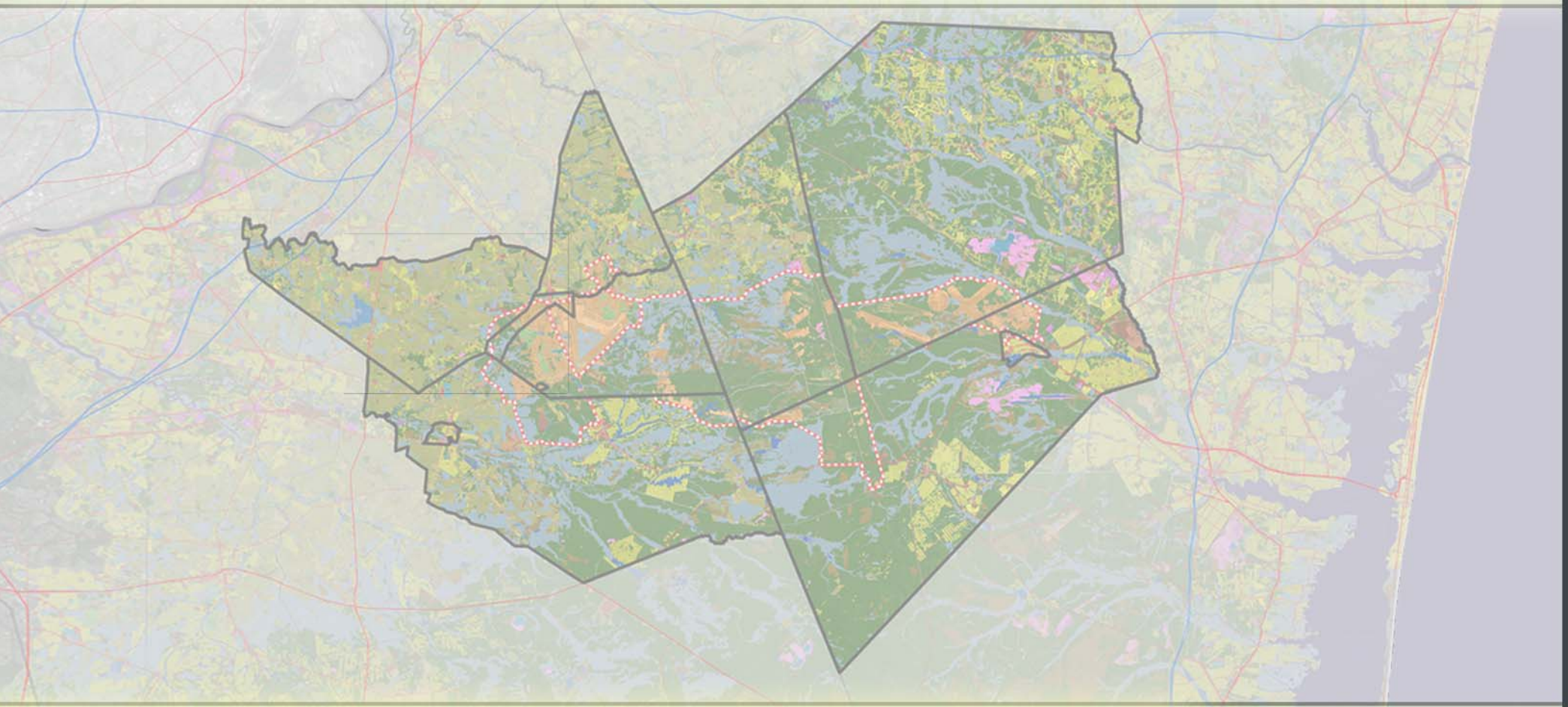
# Joint Base McGuire-Dix-Lakehurst
# Joint Land Use Study for Counties of Ocean and Burlington



## Section 13.1 - List of Acronyms

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|---|---|
| **AASF** | Army Aviation Support Facility |
| **ADNL** | A-weighted Day-Night Noise Level |
| **AFB** | Air Force Base |
| **AICP** | American Institute of Certified Planners |
| **AICUZ** | Air Installation Compatible Use Zone |
| **AIMD** | Aircraft Intermediate Maintenance Department |
| **ALZ** | Assault Landing Zone |
| **ANG** | Air National Guard |
| **ANSI** | American National Standards Institute |
| **AMC** | Air Mobility Command |
| **AMW** | Air Mobility Wing |
| **API** | Aircraft Platform Interface |
| **APZ** | Accident Potential Zone |
| **AR** | Army Regulation |
| **ARB** | Air Reserve Base |
| **ARFC** | Air Force Reserve Command |
| **ARW** | Air Refueling Wing |
| **ASD** | Aviation Supply Division |
| **AW** | Airlift Wing |
| **BAH** | Basic Allowance for Housing |
| **BASH** | Bird Aircraft Strike Hazard |
| **BOS** | Base Operating Support |
| **BRAC** | Base Realignment and Closure |
| **CALASSES** | Carrier Aircraft Launch and Support Systems Equipment Simulator |
| **CDNL** | C-weighted Day-Night Noise Level |
| **CDPT** | Compatible Development Planning Team |
| **CDR** | Commander |
| **CEC** | Civil Engineer Corps |
| **CFR** | Code of Federal Regulations |
| **CLTF** | Consolidated Logistics and Training Facility |

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|---|---|
| **CMP** | Pinelands Comprehensive Management Plan |
| **CNIC** | Commander, Navy Installations Command |
| **COAH** | Council on Affordable Housing |
| **Col.** | Colonel |
| **CRW** | Contingency Response Wing |
| **CZ** | Clear Zone |
| **DA** | Department of the Army |
| **dB** | Decibels |
| **dBA** | A-weighted Decibel |
| **dBC** | C-weighted Decibel |
| **dBP** | Decibel, Unweighted (Peak) |
| **DNL** | Day-Night Average Noise Level |
| **DNMRL** | Onset Rate-adjusted Monthly Day-Night Level |
| **DoD** | Department of Defense |
| **DOT** | Department of Transportation |
| **DPW** | Department of Public Works |
| **DVRPC** | Delaware Valley Regional Planning Commission |
| **EA** | Environmental Assessment |
| **Ed.D** | Doctor of Education |
| **EIS** | Environmental Impact Statement |
| **EJ** | Environmental Justice |
| **EMALS** | Electromagnetic Aircraft Launching System |
| **EMTF** | Expeditionary Mobility Task Force |
| **EPA** | Environmental Protection Agency |
| **FAA** | Federal Aviation Administration |
| **FHA** | Federal Highway Administration |
| **FICAN** | Federal Interagency Committee on Aircraft Noise |
| **FICON** | Federal Interagency Committee on Noise |
| **FICUN** | Federal Interagency Committee on Urban Noise |
| **FONSI** | Finding of no significant impact |

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|---|---|
| **FORSCOM** | US Forces Command |
| **GIS** | Geographic Information Systems |
| **GPD** | Gallons per Day |
| **GW** | Groundwater |
| **HE** | High Explosive Round |
| **HMH-772** | Marine Heavy Helicopter Squadron 772 |
| **HMLA-775** | Marine Light Attack Helicopter Squadron 775 |
| **HQDA** | Headquarters, Department of the Army |
| **HUD** | Department of Housing and Urban Development |
| **ICUZ** | Installation Compatible Use Zone |
| **IOC** | Interim Operational Capability |
| **IONMP** | Army's Installation Operational Noise Management Plan |
| **JLUS** | Joint Land Use Study |
| **JRB** | Joint Reserve Base |
| **JSF** | Joint Strike Fighter |
| **LEQ** | Equivalent level |
| **LITR** | Low-noise Training Round |
| **LTC** | Lieutenant Colonel |
| **Lt. Col** | Lieutenant Colonel |
| **LUPZ** | Land Use Planning Zone |
| **MAG-49** | Marine Air Group 49 |
| **MLRS** | Multi-Launch Rocket System |
| **mm** | Millimeter |
| **MOA** | Military Operating Area |
| **mph** | Miles per Hour |
| **MWSS** | Marine Wing Support Squadron |
| **MUA** | Municipal Utilities Authority |
| **NAEC** | Naval Air Engineering Center |
| **NAES** | Naval Air Engineering Station |
| **NAS** | Naval Air Station |
| **NASJRB** | Naval Air Station Joint Reserve Base |
| **NATF** | Naval Air Test Facility |
| **NAVAIR** | Naval Air Systems Command |

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|---|---|
| **NAWC** | Naval Air Warfare Center |
| **NAWCADLKE** | Naval Air Warfare Center Aircraft Division Lakehurst |
| **NCA** | Noise Control Act of 1972 |
| **NCO** | Non-commissioned Officer |
| **NCP** | Noise Compatibility Program |
| **NEM** | Noise Exposure Map |
| **NEPA** | National Environmental Policy Act |
| **NJAC** | New Jersey Administrative Code |
| **NJARNG** | New Jersey Army National Guard |
| **NJDEP** | New Jersey Department of Environmental Protection |
| **NJNG** | New Jersey National Guard |
| **NJPDES** | New Jersey Pollution Discharge Elimination System |
| **NJTPA** | North Jersey Transportation Planning Authority |
| **NLR** | Noise Level Reduction |
| **NOSC** | Naval Operations Support Center |
| **NZ** | Noise Zone |
| **ODEP** | Office of the Director of Environmental Programs |
| **OEA** | Office of Economic Adjustment |
| **ONAC** | Office of Noise Abatement and Control |
| **OSHA** | Occupational Safety and Health Act |
| **PAO** | Public Affairs Office |
| **PATCO** | Port Authority Transit Corporation |
| **PDC** | Pinelands Development Credit |
| **PE** | Professional Engineer |
| **PP** | Professional Planner |
| **PPA** | Pinelands Preservation Area |
| **ppsm** | Persons per Square Mile |
| **PS&S** | Paulus, Sokolowski, and Sartor, LLC |
| **RAICUZ** | Range Air Installation Compatible Use Zone |
| **RALS** | Runway Arrested Landing Site |
| **RCO** | Range Control Officer |
| **Ret** | Retired |
| **RMC** | Registered Municpial Clerk |

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|---|---|
| **RWPA** | Water Resource Planning Areas |
| **SADC** | State Agriculture Development Committee |
| **SAFETEA-LU** | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users |
| **SARNAM** | Small Arms Range Noise Assessment Model |
| **SEL** | Sound Exposure Level |
| **SEPTA** | Southeastern Pennsylvania Transportation Authority |
| **ppsm** | Persons per Square Miles |
| **SLUCM** | Standard Land use Classification Manual |
| **SW** | Surface Water |
| **TDR** | Transfer of Development Rights |
| **TWA** | Treatment Works Approval |
| **USACHPPM** | US Army Center for Health Promotion and Preventive Medicine |
| **USAF** | United States Air Force |
| **USAR** | US Army Reserve |
| **U.S.C.** | United States Code |
| **USN** | United States Navy |
| **USNR** | United States Navy Reserve |
| **UTES** | Unit Training Equipment Site |
| **VA** | Veterans Administration |
| **VR-52** | Fleet Logistics Support Squadron 52 |
| **VR-64** | Fleet Logistics Support Squadron 64 |
| **WMA** | Watershed Management Areas |
| **WMP** | Wastewater Management Plan |
| **WQMP** | Water Quality Management Plan |
| **XO** | Executive Officer |
| **ZOI** | Zone of Influence |

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# Section 13.3 - Policy Committee Meeting Minutes

**Meeting Minutes**

**Joint Land Use Study (JLUS)**
**Policy Committee Meeting**
**Burlington County Institute of Technology, Medford, NJ**
**October 22, 2007**

In attendance were the following:

As Policy Committee Members:
Stephen F. Childers, Mayor, Lakehurst Borough – Ocean County
Tim Borsetti, Councilman (Designee), Lakehurst Borough – Ocean County
Dan Burke, Township Engineer (Designee), Jackson Township – Ocean County
Robert Hardy (Designee), Plumsted Township – Ocean County
Dennis Roohr, Mayor, New Hanover Township – Burlington County
Louis DeLorenzo, Mayor, North Hanover Township – Burlington County
David Patriarca, Mayor, Pemberton Township – Burlington County
William H. Pettit, Sr., Mayor, Springfield Township – Burlington County
Thomas E. Harper, Mayor, Wrightstown Borough – Burlington County
Susan Grogan, Chief Planner, New Jersey Pinelands Commission

As Ex-Officio Policy Committee Members:
Richard T. Dean, Community Planner - McGuire Air Force Base
R. Eric Raaum, PE, Senior Planning Engineer - Lakehurst Naval Air Engineering Station
Dennis Blazak, Chief Environmental Engineer - Lakehurst Naval Air Engineering Station
Stacy Grillo, New Jersey Office of Smart Growth
Timothy Brill, Planning Manager, New Jersey State Agriculture Development Committee
James J. McSorley, Director-Public Policy, Christopher H. Smith, United States Congressman
John Leigh, Project Manager, United States DOD/Office of Economic Adjustment

As an Interested Party:
Emil Kaunitz, President - Friends of Navy Lakehurst

As JLUS Project Coordination:
David J. McKeon, Planning Director – Ocean County
Anthony M. Agliata, Assistant Planning Director – Ocean County
John R. Brown, Assistant Planner - Ocean County
Mark Remsa, Director – Economic Development & Regional Planning – Burlington County
David Hojsak, Principal Planner - Economic Development & Regional Planning – Burlington County

The Salute to the Flag signaled the beginning of the meeting.

On behalf of the Burlington and Ocean County Freeholders, David McKeon, Ocean County Planning Director, announced the Welcomed and Called the Meeting to Order. Each attendee introduced themselves and the entity they represented (See Above.).

Mark Remsa, Burlington County's Director of Economic Development and Regional Planning, presented an Overview of Study's Goals and Objectives. The Role of the Policy Committee was addressed by David McKeon. And John Leigh, Project Manager, from the US Department of Defense/Office of Economic Adjustment gave an overview of JLUS's from the National Perspective.

The specific components of Fort Dix/McGuire AFB/NAES Lakehurst study was presented by David McKeon and included:

- Role of the Consultant
- Draft Request for Proposal
- Designation of Working Committee Participants

Mark Remsa addressed the Next Steps for the JLUS. This was followed by a Question and Answer period.

The next Policy Committee Meeting will be scheduled sometime late in January 2008.

The meeting was adjourned.

**Meeting Minutes**
**Joint Land Use Study (JLUS)**
**Policy Committee Meeting**
**NAES Lakehurst, NJ**
**January 29, 2008**

Attendance was as follows:

Policy Committee Members:
Dan Burke, Township Engineer (Designee), Jackson Township – Ocean County
Michael Fressola, Mayor, Manchester Township – Ocean County
Robert Hardy (Designee), Planning Bd., Plumsted Township – Ocean County
Dennis Roohr, Mayor, New Hanover Township – Burlington County
James Durr (Designee), Committeeman, North Hanover Township – Burlington County
Thomas E. Harper, Mayor, Wrightstown Borough – Burlington County
Peter Sobotka (Designee), Deputy Mayor of Springfield Township – Burlington County
Susan Grogan, Chief Planner, New Jersey Pinelands Commission
John P. Kelly, Freeholder – Ocean County
Joseph Donnelly, Deputy Freeholder Director - Burlington County

Ex-Officio Policy Committee Members:
Richard T. Dean, Community Planner - McGuire Air Force Base
R. Eric Raaum, PE, Senior Planning Engineer - Lakehurst Naval Air Engineering Station
Dennis Blazak, Chief Environmental Engineer - Lakehurst Naval Air Engineering Station
Stacy Grillo, Planner - New Jersey Office of Smart Growth
Timothy Brill, Planning Manager, New Jersey State Agriculture Development Committee
Ellen Stein, Director, New Jersey Dept of Military & Veterans Affairs
Pidge Carroll, District Director - Christopher H. Smith, United States Congressman
John Leigh, Project Manager, United States DOD/Office of Economic Adjustment

Other Interested Parties:
Capt. J.C. Harding, Executive Officer, U.S. Navy, NAES Lakehurst
Geoffrey Urbanic, Administrator, New Hanover Township – Burlington County
Glen McComas, Councilman, Lakehurst Borough – Ocean County
Sid Hooper, Councilman, Lakehurst Borough – Ocean County
Heidi Hinz, GIS Program Analyst - Lakehurst Naval Air Engineering Station,
Emily Previti, Reporter, Atlantic City Press

JLUS Staff Coordinators:
David J. McKeon, Planning Director – Ocean County
Anthony M. Agliata, Assistant Planning Director – Ocean County
David Hojsak, Principal Planner - Economic Development & Regional Planning – Burlington County
John R. Brown, Assistant Planner - Ocean County
Erika Stahl, Planner Trainee – Ocean County

At 7:00 p.m., the meeting opened with a Salute to the American Flag.

Captain J.C. Harding made the opening comments. He thanked and gave appreciation for using Lakehurst base as the host site for the meeting, and thanked Chef Ian and his Ocean County Technical Vocational School students for preparing the meal. He also thanked the JLUS Policy Committee for working cooperatively and for making sure all the parties' interests were taken into account. He was also impressed by the 240 acres that were accrued recently through the Farmland Preservation program around Lakehurst Base to create a buffer between the base and civilian uses.

Freeholder John P. Kelly (Ocean County) and Deputy Freeholder Director Joseph Donnelly (Burlington County) did a formal Introduction and opened up the meeting. Deputy Freeholder Director Donnelly asked all present to formerly introduce themselves.

Dinner was served, followed by a short intermission.

1 of 2

**Meeting Minutes**
**Joint Land Use Study (JLUS)**
**Policy Committee Meeting**
**NAES Lakehurst, NJ**
**January 29, 2008**

David McKeon reconvened the meeting after the intermission. He covered a discussion about the consultant selection process and the consultant recommendation. He stated that approximately 50 companies requested information regarding the RFP and 8 qualified responses came in. Mark Remsa, David McKeon, Anthony Agliata, Thomas E. Harper, and Robert Hardy (Consultant Selection Review Committee) reviewed the proposals and choose their top three favorites independent of each other. They then sat down and discussed their choices and chose the top three consultants they felt collectively would do a thorough and excellent job with the Joint Land Use Study. Interviews were then held last week and the top consultant was chosen. The proposal amount they are seeking has not been looked at yet, but that is the next step. Financial negotiation will be taking place shortly, and then the consultant team recommendation will be given to the Ocean County Board of Chosen Freeholders for final approval. PS&S was chosen as the recommended consultant based on the fact that they are offering to gather and complete all information that is not yet made. A benefit, other consultants did not cover.

The meeting was opened up to questions regarding new information:

David Hojsak thanked Ocean County for including Burlington County in the consultant selection process.

Dan Burke asked whether the proposal followed the recommendations made during the last Policy meeting: finding a local firm with NJ Planning Knowledge, military background, and past experience with other Joint Land Use Studies.

David McKeon commented that those recommendations were used to select the consultant and were part of the Request for Proposals (RFP).

Peter Sobotka asked for a time line for the study. David McKeon responded by stating that a rough estimate schedule is to get the consultants put on the Ocean County Freeholder agenda for their February 20th meeting. Then have a start date in March for the Consultant. He also suggested that the next JLUS Policy Committee meeting should be scheduled for March 31st. At this meeting the consultant will be introduced and pertinent information regarding contacts and other useful information will be given to the consultant. March should be the time for the consultant to be introduced to contacts and start their public outreach process. The Department of Defense (DOD) requires 3 rounds of public outreach meetings but that can be negotiated with the consultant. The Consultant will also develop an interactive website for the public.

Peter Sobotka asked if the consultant was familiar with the State Process. David McKeon responded that was part of the RFP criteria that the consultant needed to meet.

Peter Sobotka asked if the consultant was familiar with the New Jersey Council on Affordable Housing (COAH) process. David McKeon responded that they had as much knowledge as everybody else did, and whatever they don't know they'll have to learn.

David McKeon then asked for the base officials to give information about any new updates they have regarding their bases and the JLUS if they choose.

Richard Dean spoke for the McGuire Air Force Base. He stated that about $3 million was granted to the Air Force from DOD and of the 3 million granted; $1 million was slated for the Air Force planning department for the acquisition of property rights for properties lying in the buffer zone. The New Jersey Pinelands have also identified some properties in the buffer zone as properties that should be acquired as well, which will add more money for acquiring properties.

Meeting was adjourned at 8:15pm.

Meeting Minutes prepared by:
Erika Stahl, Planner Trainee – Ocean County



**Fort Dix/McGuire AFB/Lakehurst NAES**
**Joint Land Use Study**
**3rd Policy Committee Meeting**
**Burlington County Vocational Institute**
**March 31, 2008**

**Minutes**

Mark Remsa, Burlington Economic Development and Regional Planning Director, and David McKeon, Ocean County Planning Director, opened up the meeting at 6:45pm. Mark Remsa asked the Joint Land Use Study Policy Committee to introduce themselves.

The Dinner Intermission was taken at 6:50pm.

The video, "Base Next Door", was played from 7:15pm to 7:30pm.

David McKeon informing the Policy Committee that the consultant chosen was approved by the Ocean County Board of Chosen Freeholders and they came in under budget. He then introduced Elizabeth McLoughlin, principle in charge for the consultant Paulus, Sokolowski and Sartor, LLC (PS&S).

Elizabeth McLoughlin gave a broad overview of the key players of the three consultants, PS&S, Sabre Systems, and HR&A. She explained that PS&S would be working with the civilian aspect of the study, Sabre Systems with the military analysis, and HR&A the economic analysis. PS&S is the lead consultant so they will be in charge of making sure the study comes together.

The goals of the study is to identify any encroachment issues, encourage cooperative land use planning, identifying compatible and incompatible land uses, and forge relationships between the civilian and military entities. This relationship should continue after the study and be actively involved in making decisions in the best interests of the population represented by the study entities.

Elizabeth McLoughlin stated that the bulk of the study is the data collection. The key is to gather GIS data and maps, so that it can be forged into comprehensive database of existing conditions and serve as the foundation for the study. This will include environmental data. Other data that should be included is infrastructure. Key questions to ask relating to infrastructure are, "Where is it located and where is it planned for?" Once all the data is gathered, the real planning can begin.

The next step after the information is gathered is to analyze the economic impact of the current situation. The data gathered and economic analysis will then be used to make recommendations for the future land use planning and set a stage for ongoing communication for all the entities involved long after the study has been completed.

Public involvement is a large part of the study. The interactive website will be a huge component in incorporating the public into the study. The public will be informed of meetings via brochures, public notice, and the website. Public meetings will be held in both Ocean and Burlington Counties.

The website will also be used as a tool to gather information from the Policy and Technical Committees and be used to keep all members informed about meeting dates and contact information.

Elizabeth McLoughlin discussed PS&S's timeline for the study. April is the first month in the data-collection process. The goal is to have all the data collected by June so that the current situation can be mapped. This will be helpful in depicting the current situation, as well as compatible and incompatible land uses to the public. Early July has been projected for the first public meeting, so that the public can have input and be informed about the study.

Once all the study entities' positions and conflicts have been identified the recommendations for future land use planning will be made. These recommendations will be developed and approved by the Policy Committee.

Sabre Systems will be investigating what the military's (as a whole) and each military base's position is, as well as gathering data from the military. Data that will be collected from the bases include Air Installations Compatible Use Zone (AICUZ) studies, AICUZ noise contours, explosive arcs, electromagnetic radiation contours, community complaint logs, operational mitigation measures, and Installation Natural Resource Management Plans. Particular noise contours and explosive arcs that will impact off-base locations will be assessed the most. New base activities and how they will impact the surrounding municipalities will also be assessed.

Municipality, county, and state data is important in the understanding of current and future land uses. Data requests for the community are as following: County and Municipal Master Plans, existing and proposed infrastructure data, approved developments, developments in progress, designated redevelopment areas, up-to-date zoning ordinances and building codes, and contacts for the municipal interview process.

This study is important to the local and state economy. There was 5 billion dollars in state-based military spending in 2002, as stated by a Rutgers, The State University study. These 5 billion dollars are broken down into 1.6 billion dollars in payroll spending and 3.4 billion dollars in military contracts. Civilians comprise a third of military on-base jobs. These jobs are well paying, and in fact yielded 30% above the statewide average. Off-base military spending contributed to more than 21,000 jobs and 1.3 billion dollars of payrolls of firms operating in the state. The multiplier affect from military spending contributed to over 90,000 jobs with 3.6 billion dollars in payroll.

This study should be looked at as an opportunity to forge relationships between the civilian side and the military. It should be thought of as a new opportunity to work together, raise public awareness, identify areas of concern, and open communication between all parties involved. The goal is to improve the quality of life and not compromise the quality of life. The study will also help prepare communities for future compatible growth, and maintain economic viability.

Elizabeth McLoughlin introduced Brandi Bartolomeo, PS&S Joint Land Use Project Manager, to further discuss the data that is needed and the process to get information to the consultant.

Brandi Bartolomeo introduced the File Transferable Portal, FTP for municipalities and the counties to submit files. She explained how to transfer files into it. Brandi stated that she would take any files in GIS format or any other format. Hard copies that have been scanned will also work. The goal is to create data layers to create a seamless map. Brandi asked the municipalities to drop off their master plans and designate individuals for the upcoming municipality interviews.

The FTP site is being used to make a "Green" Joint Land Use Study, especially since there will be a lot of data being shared. Brandi informed the Policy Committee that the following data should be dropped off: Municipal and County Master Plans, existing and proposed infrastructure data (such as roadways, water supply information, waste water, and utilities, zoning, designated open space, and Publicly Funded Capital and Infrastructure Improvements), approved developments, developments in progress, designated redevelopment areas, municipal zoning ordinances, building codes, and a list of officials to interview.

The Joint Land Use Study website will be created shortly for Policy Committee members viewing only. This will include a list of all the members and their contact information, meeting minutes, future meeting dates, and agendas. In the future Brandi Bartolomeo will upload an interactive map onto the website to visually demonstrate the progress of the study. This will work well as the public becomes more involved. The map will allow concerned citizens to view their home and how it relates to the study. Brandi then opened up the meeting for questions regarding the data collection process and the FTP site.

Mark Santilli, Fort Dix Army Master Planner, shared the fact that he would love to share information with the public but security of the data is a main issue. A lot of the data that the Fort Dix Army Base Planning Department does is interesting, but if shared would put soldiers at risk. There are ammunition locations, remote soldier areas outside the fence, and vehicle storage areas that need to be kept safe.



Elizabeth McLoughlin responded by stating the bases are absolutely not supposed to upload their information onto the FTP site. We are asking the municipalities to upload their data. Sabre Systems will collect the military information.

Bret Gordon, Project Manager from Sabre Systems, applauded Mark Santilli for asking the question and opening up dialect. Mark Santilli stated that the man who tried to compromise Fort Dix was recently sentenced. Bret Gordon continued by stating that Sabre Systems wants to know what is considered sacra or sank, or what you would not like to share. The bottom line is that this is a product of what is put in. The study will only be as good as the information that you will give us. We will work with anything and everything that you will give us. A way to figure out what kind of information to share is to find out what sister installations have shared in past Joint Land Use Studies. Some have been more open than others, most likely dependant on their mission. We understand that the Army Base, Air Force Base, and Navy Base will all have different information to share. Brandi and Elizabeth will act as liaison for the civilian side, while Sabre Systems will be the liaison for the military side. The goal is to meld the two sides together.

Brandi Bartolomeo stated that whatever effects off base, or outside the base boundaries, will be taken care of by PS&S.

Bret Gordon continued by stating that we want you to make noise. We want you to have the ability to complete your mission. We want the civilians to be made aware of that noise potential and of the sound study so that if they are building in the area that the builders or house owners can add sound attenuation products. The real estate agents will play a big role because they have to communicate what you want them to know for people buying houses in that area. We don't want this Joint Land Use Study to be like the Naval Air Station Oceana, Virginia Joint Land Use Study since they are the poster child of how not to do this kind of study. The base and surrounding communities did not work corporately together and dragged their feet. After many years of not making any progress they have learned their lesson, and know have to backtrack to get the process restarted. We do not want to put the military or the local communities in this circumstance. We should feed off of each other in a continuous basis so that the product given to you next March will be a dynamic document. It will be a snap shot in time, but a document that will bridge the civilian side and the military side. It should be used as a reference in ten years from now, even though everybody would have grown exponentially.

One of the mayors asked if the study would make recommendations for their Master Plans.

Elizabeth McLoughlin answered by stating "generally we are going to incorporate your master plans with the Counties' Master Plans to identify where this natural buffer needs to be around the base. We are going to identify locations where master plans show development is going to occur but the military base states that an incompatible use will or is occurring adjacent to that chosen location. That information will be shared so everybody can make informed decisions.

Bret Gordon stated that the study would make recommendations. The study is a snap shot of the current circumstance, however it is developing a process of communication so that if the municipalities' needs changes or the military missions expand or shrink everybody will know it and be able to react to it. We want instant communication for all parties. We will make a recommendation for 2009 but more importantly you will have a process to move forward with, so that in 2019 you will have the same open communication.

Elizabeth McLoughlin stated, "It's your master plan, and essentially we are informing you with information. You can use this information to create a more informed master plan."

Bret Gordon asked John Leigh to discuss a JLUS that is still going on now.

John Leigh, Department of Defense Office of Economic Growth Project Manager, discussed the Fort Bragg/Pope Base study in North Carolina that is still continuing today. He stated that the initial study was done 10 years ago, and an update was done in 2003. The JLUS committee recently requested to do a further study due to changes in operations, which identified new problems. In years past the study was paid for by the Department of Defense and the municipalities were left to their own devices to implement the recommendations. Now the Department of Defense Office of Economic Adjustment can and will help with the assistance in implementing the recommendations made by the Joint Land Use Study, as well as assist with further studies if need be.

David McKeon stated that planning is very uncertain especially with the state plan and the change in the wastewater rules, etc. This is a dynamic time in New Jersey. One thing that this study does is that it brings the state agencies together with the local municipalities, counties, consultant team, and the military bases so that we can work together in a coordinated fashion. It's a huge undertaking. The problem with the state plan is that it tries to solve problems on a large scale, however Newark is very different from Salem County. This study gives us a very focused area with a lot of similarities. We are going to work together knowing that there are going to be changes in the future and promises made in the past that did not come to fruition. We are aware that there are changes coming such as the wastewater rules. Where there are recommendations that come out of the study, we will work to make sure that they are justified.

David McKeon announced the first Technical Committee date for April 17, 2008. It's a group comprised of the Policy Committee's members or their staffing level professionals, such as engineers, planners, or consultants. The meeting will be in Plumsted at 10a.m., since it is a central location. The interviewing process has been brought up by the consultant and is what made this consultant stand out from the others. They feel that is important to meet one-on-one with the municipalities to find out what is going on in your town, what has worked and what hasn't worked. You may want to invite your council members, engineers, planners, etc.

Captain J.C. Harding, Lakehurst Naval Air Engineering Station Commanding Officer, asked the following question. How will the study continue in the future? What county will be in charge?

David McKeon stated that one-way or another the committee will be kept up. The database will be maintained without a consultant.

Bret Gordon stated, "a process that will nurture the study will be recommended." The website will be maintained for one year after the study ends.

John Leigh stated that some studies created a committee that meets on an annual basis to make recommendations and update information. Each study is different and in the beginning the committee might meet more often and then taper off to larger chunks of time in between meetings. The point of the committee is to look at the recommendations and the need for further study or changes. The most important point is to continue the dialogue.

Bret Gordon stated that this JLUS is unique because it encompasses three military branches, two counties, and ten municipalities. This is an opportunity for communities to talk to each other as well as the military bases. Everybody will have an opportunity to learn from each other and might find new ways to make their communities function better from shared information. The true beneficiaries will be the municipalities and the catalyst will be the military bases.

Mark Remsa stated that the commanders move on every 2 to 3 years. He wants, as well as some Mayors, a manual for new commanders that details what has been agreed upon in the Joint Land Use study so that it will live on in the military. There is an ongoing process that they need to learn about and be a part of.

Bret Gordon stated that it is true that commanders move on every few years, but they do have a civilian staff that remain constant. They are the ones that provide the expertise year in and out and are important to have communication with. The continuity will be continuing with the civilian staff. The commanders should keep on top of the study but it is the civilian staff that will be here year in and out. It is important to continue that relationship with them.

It was also brought up by Mark Santilli that the Army and Navy have the National Guard that owns their own real property on Fort Dix. They do not answer to the Fort Dix commander but their own commander.

Bret Gordon has stated that they will be brought on board as well.

David McKeon again reminded the policy committee to designate members to the Technical Committee.



David McKeon adjourned meeting at 8:25

**Policy Committee Attendance:**
Anthony M. Agliata, Assistant Planning Director, Ocean County Planning Department
Tim Brill, Planning/Program Manager, NJ State Agriculture Development Committee
Chester Broccoli, Chairman of the Land Use Board, Plumsted Township
John R. Brown, Assistant Planner, Ocean County Planning Department
Daniel J. Burke, Township Engineer, Jackson Township
Michael Georgalas, GIS Specialist II, Ocean County Planning Department
Susan Grogan, Chief Planner, NJ Pinelands Commission
Thomas E. Harper, Mayor, Wrightstown Borough
David J. Hojsak, Principal Planner, Burlington County Economic Development & Regional Planning
Sidney Hooper, Council Member, Lakehurst Borough
Glenn McComas, Council Member, Lakehurst Borough
David J. McKeon, Planning Director, Ocean County Planning Department
David A. Patriarca, Mayor, Pemberton Township
William H. Pettit, Sr., Mayor, Springfield Township
Mark Remsa, Director, Burlington County Economic Development & Regional Planning
Dennis Roohr, Mayor, New Hanover Township
Peter Sobotka, Deputy Mayor, Springfield Township
Erika F. Stahl, Planner Trainee, Ocean County Planning Department
William T. Stewart, Supervising Administrative Analyst, Burlington County
Diane P. Stinney, Council President, Pemberton Township

**Ex-OfficioCommittee Attendance:**
Greg Bury, Environmental Engineer, Lakehurst Naval Air Engineering Station
Pidge Carroll, District Director, United States Congressman Christopher H. Smith, 4th district
Richard T. Dean, Community Planner, McGuire Air Force Base
Capt. J.C. Harding, Executive Officer, Lakehurst Naval Air Engineering Station
John Leigh, Project Manager, Department of Defense/Office of Economic Adjustment
R. Eric Raaum, Senior Planning Engineer, Lakehurst Naval Air Engineering Station
Mark Santilli, Master Planner, Fort Dix Army Base

**Consultant Attendance:**
Brandi Bartolomeo, Project Manager, Paulus, Sokolowski and Sartor, LLC
Bret Gordon, Program Monitor, Sabre Systems, Inc.
Elizabeth McLoughlin, Principle in Charge, Paulus, Sokolowski and Sartor, LLC
Charles E. Mink, Program Monitor, Sabre Systems, Inc.
John Wendolowski, Director of Strategic Initiatives, Sabre Systems, Inc.

**Other Interested Parties:**
Emily Previti, Reporter, Atlantic City Press

**Joint Base McGuire, Dix, Lakehurst**
**Joint Land Use Study**
**4th Policy Committee Meeting**
**Lakehurst Naval Engineering Air Station**
**May 29, 2008**

Call to Order was made by David McKeon and David Hojsak at 7:15pm.

The consultant team presented a PowerPoint presentation that summarized the JLUS status. In May of 2008 the consultant team met with:

- Pemberton Borough
- North Hanover Township
- Wrightstown Borough
- Jackson Township
- Pemberton Township
- Plumsted Township
- New Hanover Township
- NJ Pinelands Commission
- Lakehurst NAES

These meetings were productive to gain an understanding of each Town's individual concerns and existing relationship the Base and to the local community. Each Town's meeting discussion topics were mentioned.
Major themes included:

- Redevelopment Areas
- Schools
- Pinelands
- Sewer Service Area
- Areas under Construction/In Development
- Retail Competition with Base
- Traffic Circulation

Charlie Mink discussed the progress of meetings with base representatives from Lakehurst NAES, Fort Dix, and McGuire AFB as well as what data had been collected/received from the Bases for integration into the JLUS.

Many niche issues had come up through the initial meetings with the municipalities and a wastewater needs discussion was introduced by David McKeon and the topic was discussed by Rick Brown from the NJDEP.

- David McKeon gave an overview of the situation in Plumsted, North Hanover, and New Hanover.
- Rick Brown discussed the need for synergy between the bases and the local municipalities. "Let's get everything out in the open."
- Mark Santilli stated that there is a congressional Inquiry into the wastewater treatment. There is the capability to expand it, but it needs congressional approval and funding, as well as permits
- Rick Brown stated that NJDEP will give the permits to expand it to include enough capacity for the municipalities and for future growth of the base. Since we have all parties at the table through the Joint Land Use Study the process of getting the permits would be expedited.
- Mark Santilli stated that Fort Dix Commanders and Officers need to be approached in such a fashion as to not offend them. There is a way to still possibly get wastewater treatment to Plumsted – it's not fully taken off the table. The Commanders and Officers want to know that Plumsted doesn't just want to take from them and give nothing back in return.
- David Hojsak stated that the military base shouldn't feel that they always have to say yes. He can accept a no. As far as he is aware the sharing of wastewater facilities with Burlington county municipalities has been taken off the table.
- Captain Harding, stated that nothing should be taken off the table yet. Let's keep all options on the table even if they don't seem feasible now. They could become feasible in the future. He also stated that the military's relationships to the community have changed post 9-11, and a new strategy for collaboration must be found. He also stated that monetary resources may become available and that the military leaders at each base were open to discussion of these issues.
- Erika Stahl stated to Mark Santilli that Ocean County does want to keep that option open if it will assist Plumsted Twp.
- David Hojsak brought up the issue about other possible niche issues:
  1. Addressing retail competition between the municipalities and the military bases – he feels this can be addressed by the study
  2. Transportation, circulation issues (closure of Texas Avenue took passing traffic from Wrightstown and surrounding municipalities and gave to other municipalities) – this is an issue he does not feel will be solved by the JLUS
- Dave McKeon stated that studies to focus on these niche issues were out of scope of the project's basic land use mandate, and added that additional niche issues included:
  1. Transfer of development rights (TDR)
  2. Economic diversification
  3. School children of military and funding to local schools

State Plan Endorsement Inter-Agency Meetings were introduced by Rick Brown (NJDEP) and further discussed in detail by Lorissa Whitaker from the Office of Smart Growth.

- Rick Brown stated that bases will get a Plan Implementation Agreement, which is a 10-year contract for endorsed time. This is the best way to go for military bases that want to make sure the agreements will continue to live on.
- Lorrissa Whitaker stated that the Plan Implementation mechanism gets the office of smart Growth blessing, along with other state agencies blessing (many of them who are represented in the JLUS study). She also discussed her office's enthusiasm for the project and its relationship to their State Plan process in the mutual goal of identifying where growth should occur. Ms. Whitaker stated that each plan endorsement process was linked to a municipality's master plan and then to state priorities. There is opportunity here also for grant funding to prioritize action in designated centers through plan endorsement agreements for Plumsted or North Hanover, for example.
- Plumsted is the furthest along in the Plan Endorsement process followed by New Hanover.

Public Meeting Discussion

Brandi Bartolomeo opened up the public meeting discussion. Public meeting has been planned for July of 2008 but, many members of the Policy Committee felt that the public meetings were too soon and that a large population would be unable to attend given the large number of people that usually vacation in July.

- Mark Santilli and Rick Brown both suggested that the meetings should be moved to September. This will allow for more public outreach and to get editorial boards circulating.
- Mayor Patriarca suggested that we contact the Asbury Park Press for editorial boards. He also informed the policy committee that Pemberton High School runs their own infomercial programs; there is a great possibility of using that venue for free. The programs get broadcast on the Comcast network. Ocean County Community Colleges and Burlington Community Colleges might also be possible sources for infomercial programming assistance.
- Captain Harding stated that the study should use web-enacted tools, use the press and media, and Comcast as a forum as suggested by Mayor Patriarca.
- Peter Sobotka stated that the county libraries should be used as a forum to spread information.

It was decided at the end of the Policy Committee meeting that the public outreach meetings would be postponed to this September (2008) after schoolchildren are back to school. The next Policy Committee meeting would be held at the end of July and would focus on study progress and the upcoming public meetings.

The meeting adjourned at 9:00pm.

Meeting Minutes
Burlington County
Emergency Services Training Facility
July 29, 2008
6:30 –9pm

Burlington County Freeholder Joseph Donnelly called the meeting to order at 7:15pm.

Brandi Bartolomeo, Paulus, Sokolowski & Sartor, gave a summary of the status of the Joint Land Use Study (JLUS). In the months of May and June all ten participating municipalities, Pinelands Commission, three military bases, and the National Guard met with the consultant teams and county representatives individually. The Joint Land Use website has been made public and a section of it will still function as a member only site. The data-gathering phase is nearing completion and the data interpretation phase has begun. GIS compilation data information will be handed out to each individual municipality during this meeting for verification and correction purposes. The Joint Land Use Study will move forward with the public outreach and economic component of the study.

Brandi Bartolomeo presented key concerns and facts that have been uncovered during the individual meetings with the municipalities held in the month of June. Manchester Township's key concerns revolved around residential development around Lakehurst base, since they have received pressure to develop in the Golden Triangle site, Heritage Minerals site, and Retreat at Manchester. Manchester Township has a large senior citizen population, about 80 percent. Manchester also has an avigation easement at the Pulte Homes located across from Lakehurst base. The township's history in working with the military has had its ups and downs.

Springfield Township's major industry is agriculture and the township is pro farmland preservation. They have 4500 contiguous acres of farmland. Springfield Township does not have sufficient water or sewer capacity for future growth, or much of a commercial area.

Lakehurst Borough is actively working with Lakehurst base to define and determine the best use for the redevelopment area. There is little growth projected for the borough. Lakehurst Borough mentioned working with the base regarding re-opening the back gate to Lakehurst base. The borough supports the reopening of the Monmouth Ocean Middlesex (MOM) rail line, which runs through the borough.

Brandi introduced Bret Gordon from Sabre Systems who stated, that we have had various degrees of success in getting information from the military bases. Lakehurst has been the most cooperative base, but we are missing key information from McGuire and Fort Dix. Sabre Systems has solicited them for this information. He implored the committee members to please ask the military bases to provide the information we are looking for. The information being asked is very basic, and with it we will be able to put out a better product.

Sabre Systems had the opportunity to sit down with all of the commanding officers and other military interested personnel (planners, engineers, land use development, public services, etc.). The purpose was to reinforce the importance of the Joint Land Use Study and identify whom it will benefit. Sabre Systems tried to emphasis that the military is a large beneficiary because they get to retain their missions. The bottom line is that the municipalities will benefit as well, and it's a win-win situation for both sides. This is an opportunity to reinforce what is happening on this large joint military base. The Joint Land Use Study is the

catalyst for future jobs and local economies both in Ocean and Burlington counties. The more information we can get not only from the military side, but also the municipalities the better the product and the more it will benefit both sides.

There is positive momentum from Fort Dix. Noise contour data is being evaluated. McGuire Air force base, Commander Ayyer, was convinced that the Joint Land Use Study is a good thing for McGuire. There will be a personnel increase on McGuire from the transfer of closed missions on Willow Grove base. This increase in personnel will generate more revenue for the local area. There are more construction opportunities on McGuire Air Force Base, which could mean more local jobs. An AICUZ study (noise study) is underway and will be completed shortly. The AICUZ data will not take into consideration the new aircraft coming in, that will be done by year 2010. The 2010 AICUZ will cover the entire Joint Base McGuire, Dix, Lakehurst. This highlights that the JLUS document we are creating will be a working dynamic document, not just a static picture of the present.

The National Guard is a tenant on McGuire, Fort Dix and Lakehurst Base. Their members do not typically interact as a unit and necessarily live near the base. However, they still bring money into the community and commute in and out of the community to get to work. They have a ton of projects going on right now: The National Guard is building on Route 539, which stands between Lakehurst Base and Fort Dix, a 70 million dollars consolidated Logistics and Training Facility. Also by 2011 a hanger facility will be built on Lakehurst base to house all of the NJ National Guard Helicopters. All of this construction and new missions equate to more jobs in the long run. They are also responsible for the 108's on McGuire Air Force base, which are responsible for refueling.

Brandi Bartolomeo asked all the municipalities to collect their handouts from the back of the room at the end of the meeting, which consists of 3 copies of the GIS maps and a table with lots and blocks corresponding to the maps. Manchester and Jackson were not provided handouts due to the fact that the consultant just received their information or in the process of receiving their information and did not have time to process it. She asked those in attendance to verify the information and inform her of any incorrect data that is found so that it can be corrected.

Rick Brown from the Department of Environmental Protection brought up the issue of farms being classified as vacant lands because they are considered a use.

Brandi stated, "That we are not discounting the use, but looking at zoning. All unpreserved farms were classified as vacant because they could easily be converted to a different use and as the study moves along this will change. It will remain as a semi-permanent status."

Rick Brown commented that redevelopment areas should be categorized as vacant as well under this formula.

Brandi acknowledged Rick Browns comments. She then asked the municipalities to bring their maps to their planners and engineers to check them for accuracy and get back to her.

Mark Remsa asked Brandi when and how she would like the municipalities to respond back to her in regards to changes that need to be made on the GIS maps.

Brandi stated email, phone calls, fax, or any format.

Mark Remsa asked Brandi if she wants them to mark it up and scan it to back to her.

Brandi stated, scan, faxed, or mailed hard copy is fine. Even a phone call with a lot and block will do. She asked for a quick response from the municipalities.

The Mayor of Springfield, William H. Pettit, brought up the issue of COAH and the importance to his community. It's something we have to plan for. We have a lot of agriculture, so we don't need that much but we still have to plan for it.

Brandi mentioned that we are aware of COAH obligations.

Elizabeth McLoughlin introduced the economic component of the study. HR& A are economic advisors. They specialize in doing market analysis and military based economic analysis. They are coming on board now, since most of the military and municipal information has been gathered. They will be focusing on studying the base line, current and future trends, of Ocean and Burlington County. They will use the land use data to identify what would be the key component driver of a land use in particular areas and target those sites. They will also have an overall economic model for the impact of the new missions on the military bases. HR&A will be attending the next policy meeting to make a presentation.

Brandi informed the policy meeting that the login page was moved due to the website becoming public. To get to the committee website directly add a forward slash after login. The current committee website will stay as it is. The Committee website does have two new surveys for committee input; one for non-military committee members and one for military-members. The public website will include an interactive mapper, as well as a public questionnaire.

Brandi had suggested that any source used for making the recommendations could be added to the website, such as master plans, zoning maps, etc. This could be helpful for local communities who do not have websites or have not scanned their documents.

David Hojsak brought up the point that we wouldn't want to leave out of date information on the website.

Brandi stated that only sources used to create the Joint Land Use Study recommendations would be posted. PS&S has already scanned the municipalities' documents.

David Hojsak stated that all municipalities should be contacted to gather their permission to upload their data onto the website.

Pat Austin stated that the mapper shouldn't be presented to the public until it is fully complete, because some members of the public would discredit the study just based on that.

Brandi stated that the mapper would be added to the policy committee webpage and not onto the public part of the website until it was completed.

Rick Brown suggested that Brandi and PS&S model the Highlands website which used the resources of Google map and added their own layers. Sour Lands Mountain region has used a mapping system where they attach notes to specific areas of the map.

John Reiser stated that it is important to make a composite map which shows which areas are planned, which show single-family residential, multi-family, etc. The information needs to be simple for the public to understand.

The Public Open House meetings will be held on September 15, 2008 at the Regional Day School in Jackson for Ocean County and September 18, 2008 at the Burlington Vocational Technical Community College for Burlington County.

The public survey will be ranked one through five. Questions will be: Are you aware of the Joint Land Use Study, Do you consider the military to be an asset, Do you think the military is good for the regional and local economies, etc. The public survey will be online because all online survey information gets compiled and quantified.

David McKeon asked Brandi if there was anyway to ask the public to inform us where they lived so that we could map the responders.

Brandi stated that it could be done. IP addresses could also assist in tracking responses. We can make zip codes and town names as a mandatory field.

David Hojsak stated that zip codes in Burlington County stretch into many other towns since it is rural.

Charlie Mink stated that "a zip code plus four would identify the correct town", however Brandi Bartolomeo and the rest of the committee agreed that most people do not know their 9-digit zip code.

Brandi asked the committee if they thought that names should be required on the public comment

Bret Gordon stated that there is no point to make it a mandatory field or to ask for it.

David McKeon stated that a person should be allowed to enter their name and contact information if they would like future information.

Rick Brown asked, "What do we want to get out of the survey? I think the questions are too loaded and might confuse the public. Ask the questions in a yes-no format instead of a rated format. Allow space for the public to input why they agree or disagree with the question."

Brandi stated that she agrees with Rick regarding changing the format.

Bret Gordon stated that the survey would inform the public as well as get input from them. The public website and public outreach should also be another avenue to educate the public.

Brandi also passed out a draft public handout for committee input. Rick Brown stated that it was hard to find the information on the flyer for the public meeting dates. Erika Stahl, Ocean County Planning Department stated that the dates and locations should be more visible by making them larger and centered with a small description about the meetings. David McKeon stated that the space where the municipalities are listed should be removed and replaced with the dates and location of the meetings. There was input from another policy committee member that the municipalities names could be used as a border instead of put in a paragraph form.

Michael Gorman, the Pemberton School Superintendent suggested that the flyers be distributed through the school system and dropped off at community centers and municipal buildings. He also suggested that the date of the public meetings be changed since it is around the time when students return for the new school year.

Brandi stated that it was brought up in a past policy meeting, where it was decided that mid-September would be the best time for the meetings.

Erika Stahl presented a Joint Land Use Study infomercial to the Policy Committee for input. Bret Gordon stated the infomercial needed to be rephrased to be all-inclusive.

Brandi Bartolomeo presented news article topics related to the Joint Land Use Study. Bret Gordon stated that the Cyber Command would be a win-win situation for the local military bases and the local municipalities since it would bring high paying positions to the region.

Mayor Harper of Wrightstown described his second term honorary position with Joint Base McGuire, Dix, Lakehurst base. The McGuire Honorary Commander Program was created as a liaison to local business and civic members and to inform the local communities of what is happening on the base. Mayor Harper informed the committee how the military gave him a tour of the bases and allowed him to attend some ceremonies and meetings on the base.

Erika Stahl, Ocean County Planning Department, asked all participating municipalities to pick up their Joint Land Use Study poster and flyers for their communities.

The meeting was open to public comments

It was suggested that economic information should be presented to the public, so that they can see that the military bases in a better light.

Mayor Patriarca of Pemberton Township, stated that the negative aspects of the expansion of the military missions should also be presented to the public. The negative aspects are areas in need of economic redevelopment, the economic standing with our school systems, road closures and lack of funding for emergency services. He also stated that surrounding municipalities need to prepare for a plane crash and other types of emergencies relating to the base, yet get no funding for it.

Brandi stated that his perspective has been noted.

Mayor Patriarca, Pemberton Township, reiterated that the encroachment study doesn't make sense for his area because the township's buffer with the base is the town's only developable land and the base is going to do what they want with it. The real issues for his community are schools, road closures effect on economy and emergency services.

Bret Gordon stated that the military does see that there are impacts to the community. The military sees compatible development, not just development in general. They do not want to prevent development but wants to encourage compatible development.

Rick Brown stated that the military bases should show by payroll where the base personnel reside.

Bret Gordon stated that Rutgers University did such a study a few years back.

Charlie Mink stated that the personnel residence information will be mapped by zip code and is underway now.

Rick Brown stated that absentee landlords are also a problem affecting the communities, as well as other housing problems. These absentee landlords usually do not take care of their property as well as those living in the community. Megabase impact on housing should be looked at in a further study.

David Mckeon stated that the transportation issues, housing issues, redevelopment issues and school issues will be well-documented so that they can be further looked at. This study focuses on land issues pertaining to encroachment.

Michael Gorman, Pemberton Township Superintendent of Schools, had asked if the 500 children were in addition to the already projected increase. He stated that Pemberton Township is ready for these additional

students, however the New Hanover school district would require more teachers, classrooms, and infrastructure if the school children are transferred to their school system.

Brandi stated that she believed the 500 children were in addition to the previous projections.

Erika Stahl brought up an article from the Fort Dix Times that stated that 50 percent of the military is married, more than the World War II peak. This means that there is an increase of young families and could be a potential problem down the line if the bases are not ready to take care of this influx of families.

Michael Gorman stated that is something they are keeping an eye on. There is a disproportionate amount of young children compared to typical families, since most of the parents tend to be in their twenties.

Bret Gordon stated that this is already part of the in-processing phase. The military member is asked about how many dependents he/she has and their ages. This information is relayed to the school system.

Michael Gorman stated that 250 students live on base and 1000 live off base already. He wanted to know how many families are projected to move from Willow Grove to the Joint Base.

Mayor Patriarca was concerned that the lack of uniformed military presence is not a good sign and asked why there aren't commanders from the bases participating and do they take the study seriously.

Bret Gordon stated the military funded 90 percent of this study.

David McKeon stated that John Leigh couldn't be here, but he has been here every other meeting. He is aware that there are other underlying issues besides the encroachment issue. However, those issues cannot be studied under this Joint Land Use Study but will be eligible under additional funding in the future and they should be studied.

Bret Gordon stated, the military changes leadership every two years, but the civilians provide the continuity year in and year out. Bret stated that a request could be made to the military bases if it would bring comfort to the policy committee members. Bret said, "Just because you don't see those in uniform does not mean that they are not engaged. We have been and are getting military civilian personnel attendance at our policy meetings."

Mayor Patriarca stated that based on past experiences we are asked by the military to give but we never hear what they are willing to give back. It would be nice to hear them state what they would be willing to work on.

Mark Remsa stated these types of concerns would be relayed back to the department of defense.

John Reiser, NJDEP, commented that a section should be added to the questionnaire where respondents could mark if they are enlisted, and if so, if they are permanent or temporary residents in the area/base. Also, the respondents should be asked where they plan to be in the next couple of years, so we can find out if they are part of the continuity of the base.

Meeting Adjourned 8:30pm.

**Fort Dix/McGuire AFB/Lakehurst NAES**
**Attendees – Joint Land Use Study**
**5th Policy Committee Meeting**
**July 29, 2008**

Anthony M. Agliata, Assistant Planning Director, Ocean County Planning Dept.
Pat Austin, Business School Administrator, Pemberton Township
Sara Banks, Systems Analyst, Lakehurst Naval air Engineering Station
Brandi Bartolomeo, JLUS Project Manager, Paulus, Sokolowski & Sartor, LLC
Dennis Blazak, Chief Environmental Engineer, Lakehurst Naval Air Engineering Station
Timothy Brill, Planning Manager, NJ State Agriculture Development Committee
Chester Broccoli, Chairman, Plumsted Township Planning Board
Rick Brown, Planner, NJ DEP
Daniel Burke, Township Engineer, Jackson Township
Scott Cadigan, GIS Specialist I, Ocean County Planning Dept.
Pidge Carroll, District Director, (Christopher H. Smith, U.S. Congressman) 4th District
Bill Chandler, Designee, Manchester Township
Richard T. Dean, Community Planner, McGuire Air Force Base
Joseph Donnelly, Deputy Freeholder Director, Burlington County
Bret Gordon, Program Manager, Sabre Systems, Inc.
Michael R. Gorman, Ed. Dtr., Superintendent of Schools, Pemberton Township
Stacy Grillo, Planner, NJDCA, Office of Smart Growth
Robert Hardy, Plumsted Twp. Planning Bd., Plumsted Township (Designee)
Thomas E. Harper, Mayor, Wrightstown Borough
David J. Hojsak, Principal Planner, Economic Dev. & Regional Planning Burlington County
John P. Kelly, Freeholder, Ocean County
David J. McKeon, Planning Director, Ocean County Planning Department
Elizabeth McLoughlin, Principal in Charge, Paulus, Sokolowki & Sartor, LLC
Charles E. Mink, P.E., Program Manager, Sabre Systems, Inc.
Lou Mraw, Manager, NJ Dept. of Community Affairs
David A. Patriarca, Mayor, Pemberton Township
Stacy Perrine, Assistant Planner, Ocean County Planning Department
William H. Pettit, Sr., Mayor, Springfield Township
Jill Priar, Chief Real Property, NJ Dept. of Military & Veteran's Affairs
R. Eric Raaum, PE Senior Planning Engineer, Public Works Dept., Lakehurst Naval Air Engineering Station
John Reiser, Planner & GIS Specialist, NJDCA, Office of Smart Growth
Mark Remsa, Director, Burlington Economic Dev. & Regional Planning
Jeff Sagnip, Congressional Aide, US Congressman Jim Saxton's Office
F. Lyman Simpkins, Mayor, Pemberton Township
Peter Sobotka, Deputy Mayor, Springfield Township
Erika Stahl, Planner Trainee, Ocean County Planning Department
William T. Stewart, Supervising Admin. Analyst, Burlington County
Bill Tilton, Deputy Mayor, North Hanover Township (designee)
Kenneth Vanderzeil, Councilman, Manchester Township
Peter L. Ylvisaker, Executive Director, Main Street New Egypt, Plumsted Township

PS&S
integrating design & engineering

Paulus, Sokolowski and Sartor, LLC
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Warren, NJ 07059
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# Meeting Report

| | | | |
|---|---|---|---|
| Project Name: | Joint Base Land Use Study | Date of Report: | December 11, 2008 |
| Project No.: | 03143-0005 | By: | Elizabeth McLoughlin |
| Meeting Location: | Policy Committee | Meeting Date: | October 29, 2008 |
| Participants: | See list of attendees | | |
| Distribution: | Public | | |

1. Call to order by Dave McKeon

**2. Summary of Joint Land Use Study Status**

The data gathering stage is almost complete; with the receipt of noise data we will begin land use analysis.

**3. Summary of September 2008 Open Houses**

Brandi Bartolomeo presented a summary of open public house meetings. Two open houses were held; September 15th for Ocean County, in Jackson Township and September 18th for Burlington County in Pemberton Township. Advertisements were placed in five newspapers and online community calendars, fliers were sent to the municipalities and Pinelands Commission for public distribution. Each municipality was afforded a display of GIS mapping including zoning, environmental constraints and preserved lands within a 2-mile buffer of the military base. The Department of Defense "Base Next Door" video was presented with inserts from Ocean County Freeholder Kelly and Burlington County Freeholder Donnelly. McGuire, Dix and Lakehurst were all represented at the open houses. Both online and paper copy public surveys were available to the public, as well as an interactive online map station. Handouts were also available. The military base personnel attendance allowed for direct access to members of the public with comments or questions. Ocean County's Open House had fewer than 20 attendees. Burlington County's Open House attendees approximated 100 persons. Pemberton and Jackson Townships had the highest attendance of the municipalities involved.

**4. Results from the Public Surveys and Overview of Interactive Web-Based Mapper**

There was approximately 50 public surveys completed online and in person. The survey data indicated that 30-40% of the responses fell in a minimally impacted category for how the bases affect their households. In response to whether the bases affected their community, the majority of responses fell in the minimally affected category, with the exception of road closures due to base activity or security, with 26% of responses checking that their community was greatly impacted.

PS&S will proceed in reliance on this report. Any discrepancies should be brought to our attention in writing within (7) days.





The vast majority, 79 percent of responders, stated that the military was a valuable asset to their community. The following is a breakdown of responses that were "very concerned" about the following issues with regard to the military presence in their community:

| | | |
|---|---|---|
| Public welfare | 18.4% | (7 respondents) |
| Local Economy | 36.8% | (14 respondents) |
| Environmental Concerns | 27.0% | (10 respondents) |
| Heightened Security Concerns | 20.5% | (8 respondents) |
| Temporary Military Residents | 14.3% | (6 respondents) |

28.9 percent of respondents are military or veterans, and 15% are civilians employed by the military. Respondents were allowed space to write in their concerns and this section was summarized for the Policy Committee.

**5. Overview of the JLUS Economic Analysis**

Dave McKeon discussed the recent Ocean County seminar regarding "Doing Business with the Military". It was very well attended, and is consistent with the type of economic analysis for the JLUS.

Candace Damon of HR&A presented the preliminary economic findings:

The role of the economic analyses is to:
a) identify best development sites within study area
b) develop complementary uses to base mission while enriching community

Summary findings are:

- Ocean and Burlington Counties are similar to New Jersey as a whole however, more affluent in some areas
- Both counties have grown rapidly relative to the State:
  - Seniors have driven recent growth in Burlington
  - Ocean County has a comparatively large senior citizen population
  - Counties' employment is similar to New Jersey's except more dependent on education and health services and less professional services that State of New Jersey as a whole

This creates an opportunity for improved linkage between base and sources of local economic strength.

- Focus on educational expansion and a curriculum on base mission. A working group of education leaders and military base staff is recommended.

- Manufacturing is strong in Burlington with 19,500 jobs, high paying, but projected to decline. Therefore, link sizeable computer and electronic production subsector to Lakehurst's bases: R&D mission and stem manufacturing decline. Convene working group of local manufacturing and base officials to expand local contracting opportunities for just-in-time manufacturing electronics and technology needs.

- Evaluate incentives and recruiting and site opportunities

- Take advantage of demographic trends to bolster employment: Health Care/social assistance sector.
  - Grow health care/social assistance professions to support veterans and promote area as retirement destination
  - Focus health care growth on higher paying subsectors including Philadelphia hospitals and nurturing of Deborah Heart & Lung Center
  - Explore linkage with retiree population

- Retail, food and accommodation is increasingly vital but low-paying
  - Target sector growth keyed to demographic changes
  - Promote smart location and product mix

- Talk to brokers and planners to identify submarkets and locations with demand for accommodation, food and retail growth.

- Assess demand for local agricultural products, especially as health option for seniors.

The next phase of the economic analysis is to explore benefits of optimal site development using the analysis from the noise and land use components of the JLUS.

**6. AICUZ Mapping**

PS&S and Sabre Systems have received some but not all noise data from the military. The consultant team is still waiting on McGuire AICUZ data and helicopter flight path data. A noise chart was used to relate noise examples to the decibel levels displayed on the maps presented.

To date we have:

- Lakehurst - Accident potential zones
  Noise level zones

- McGuire - Accident potential zones
  Noise level zones from 2005 and awaiting the new AICUZ data

- Fort Dix - Large arms noise contours
  Small arms noise contours

The team will work to procure the preliminary AICUZ data from McGuire to utilize in the analysis. A discussion with the policy committee ensued. It was mentioned by Mayor Patriarca that residents had noticed new flight patterns over Browns Mills. Colonel Polhemus responded that the flight patterns were going to be for a limited time and would cease in the next few weeks.

**7. Next Meeting**

The meeting concluded with a schedule for the next policy committee meeting to be held on December 18, 2008.

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**Joint Land Use Study**
**6th Policy Committee Meeting**
**October 29, 2008**
**Attendee List**

Anthony M. Agliata, Assistant Planning Director, Ocean County Planning Department
Sara Banks, Lakehurst NAES
Brandi Bartolomeo, Associate GIS Coordinator, PS&S
Dennis Blazak, Chief Environmental Engineer, NAES Lakehurst
Tim Brill, Program Manager, New Jersey State Agriculture Development Committee
Dan Burke, Township Engineer, Jackson Township
Scott Cadigan, GIS Specialist 1, Ocean County Planning Department
Candace Damon, AICP, P.P, HR&A
Ed Fox, Economic Development & Regional Planning, Burlington County
Bret Gordon, Program Manager, Sabre Systems, Inc.
Susan Grogan, Planner, New Jersey Pinelands Commission
Capt. J.C. Harding, Executive Officer, US Navy, Lakehurst NAES
Robert Hardy, Member of Planning Board, Plumsted Township
Thomas E. Harper, Mayor of Wrightstown Borough
Matthew Harrison, Economic Analysis for JLUS, HR&A
Sidney Hooper, Council Member, Borough of Lakehurst
John P. Kelly, Freeholder, Ocean County
John Leigh, Project Manager, US Department of Defense/Office of Economic Adjustment
David J. McKeon, Planning Director, Ocean County
Elizabeth McLoughlin, Principal-In-Charge, PS&S
Charles E. Mink, P.E., Program Manager, Sabre Systems, Inc.
Lou Mraw, Manager, NJ Department of Community Affairs Division of Codes
David Patriarca, Mayor of Pemberton Township
Stacy Perrine, Assistant Planner, Ocean County Planning Department
Col. Mike Polhemus, Director of Staff, 305th AMW McGuire AFB
R. Eric Raaum, PE, Senior Planning Engineer, Lakehurst NAES
Mark Remsa, Director, Economic Development & Regional Planning, Burlington County
Dennis Roohr, Mayor of New Hanover Township
Peter Sobotka, Deputy Mayor, Springfield Township
Erika Stahl, Planner Trainee, Ocean County Planning Department
William T. Stewart, Supervising Administrative Analyst, Burlington County
Diane P. Stinney, Council President & JLUS Council Laiason, Pemberton Township
Craig Wallis, Council President, Manchester Township
Lorissa Whitaker, Principal Planner, NJ DCA, Office of Smart Growth

**Joint Base McGuire, Dix, Lakehurst**
**Joint Land Use Study**
**7th Policy Committee Meeting**
**Plumsted Township Municipal Building**
**December 18, 2008**

Dave McKeon, Ocean Count Planning Director, called the meeting to order at 3:20pm.

New Policy members introduced themselves and Brandi Bartolomeo, PS&S JLUS project manager, discussed the planned meeting agenda.

Brandi Bartolomeo introduced PS&S Noise Expert, Mike Barboza. Mike Barboza presented the JLUS noise analysis and gave an overview presentation of Joint Base APZ's and AICUZ data. Mike discussed the basis for the noise analysis.

Air Safety Zones or APZ zones, stretch from 2.5 to 2.8 miles from the end of each operating runway. There are three main air safety zones: Clear Zone, Accident Potential Zone I (APZ I) and Accident Potential Zone II (APZ II). Within each designated safety zone, there are land use compatibility guidelines. The guidelines were discussed while viewing map slides showing APZs for McGuire AFB and NAES Lakehurst along with current aerial imagery and zoning designations.

Mike Barboza, presented an overview of noise basics before delving into the AICUZ data and analysis. Sound and noise are often used synonymously. Noise descriptors, common activities and their accompanying sound levels, and ongoing military programs were discussed.

Noise Zones for the JLUS are Noise Zone I, Noise Zone II, and Noise Zone III, and the Land Use Planning Zone.

- Noise Zone I residential and other noise sensitive land uses are considered "compatible"
- Noise Zone II noise exposure within this area is significant and it is recommended to limit land use to non-sensitive activities, such as industrial, manufacturing, transportation, agriculture and resource production normally incompatible with residential and other noise-sensitive land uses
- Noise Zone III noise is severe enough to cause conflicts with almost all activities, incompatible with residential and other noise-sensitive land uses
- Land Use Planning Zone noise environment at the installation varies daily and seasonally
    - The Land Use Planning Zone (LUPZ) contour more broadly encompasses off-base lands
    - The LUPZ is a planning tool for better prediction of variability in noise conditions/impacts buffer between NZ I and NZ II

Baseline and Projected noise conditions were presented to the Policy Committee. Mike Barboza stated that noise contours are not obsolete, can change in a day, month, etc.

Charles Mink, from Sabre Systems asked whether the 10 decibels required for nighttime noise was added to the average. Michael Barboza answered yes, it's an average of day and night decibel levels.

A noise complaints map was shown to the committee. Complaints made to NAES Lakehurst were mapped. There were a good number of recent complaints that were outside of the noise contour mapped regions.

Rick Brown, NJDEP, asked if cloud cover affects it, because from his experience he noticed an increase during these days. (Answer: yes)

Rick Brown, NJDEP, asked:
- Can modeling pick up contours, elevations and weather information?

Mike Barboza, PS&S noise analyst responded:
- The Consultant team didn't gather the information, info. The data was provided by the bases, but usually modeling covers contour and elevations changes. Not always weather.
-

Rick Dean, McGuire AFB Planner, stated:
- McGuire data doesn't take weather into account but does take into account contours and elevations.

Robert Turnbo – Airspace Manager for McGuire AFB, stated:
- It is possible for the noise to have traveled outside of the modeled areas. Once there are two or more planes flying by in the same flight path you will get accrual of noise which could travel to the West Lake region in Jackson. Military practices inside the circle TABS, which means planes will fly down as low as 500 ft.

Brandi Bartolomeo PS&S JLUS Project Manager stated:
- Fog and cloud cover accelerates noise.
- McGuire is currently creating new AICUZ data.

Mayor Patriarca, Pemberton Township, asked:
- How is this Data from 2005 going to help when activity increase is occurring now and will max out in 2011?

Dennis Blazak, NAES Lakehurst, responded:
- Data includes all operations (new and not on base now) and will be tweaked in the future. The current data takes into consideration max. Capacity at base, even though it is not at max currently. Some helicopters are overseas.

Rick Dean, McGuire AFB stated:
- KC-110's were included in draft of new AICUZ study

Rick Brown, NJDEP, asked:

- Does this current data take into consideration different conditions? If not something to work on for the next AICUZ study (# of planes on flight path, weather, etc.)

Joe Schwartz. Fort Dix, stated:
- Fort Dix is projected to have less large arms and more small arms.

Dennis Blazak, NAES Lakehurst, asked:
- Will the preliminary recommendations be uploaded to the website?

Brandi Bartolomeo PS&S JLUS Project Manager responded:
- Yes, the recommendations will be posted on the policy committee website.

Daniel Kennedy, Burlington County Farmland Preservation Coordinator, asked:
- Who is the Legal Authority of properties located in the APZ? What are the consequences of not following the recommendations?

Daniel Glasson, DoD, OEA responded:
- The Federal Government has no regulations. Constitution claims Home Rule so municipalities will be in charge of making the recommendations.

Daniel Kennedy Burlington County Farmland Preservation Coordinator responded:
- Hierarchy matters, the county over the municipalities, state over counties and federal over states.

Daniel Glasson, DoD, OEA responded:
- There are very few times the Federal government will be legally impacted by the location of APZ's or AICUZ markings from a JLUS recommendation. This relation is due to demarcation impact.
-

Rick Brown, NJDEP, stated:
- TDR or Contiguous Clustering could be used to solve problem

Daniel Kennedy, Burlington County Farmland Preservation Coordinator, asked:
- This information has been out for years, why should the municipalities make changes now?

Elizabeth McLoughlin, PS&S Principal in Charge responded:
- This JLUS is the first trigger of a Land Use Implementation process.

Daniel Glasson DoD, OEA responded:
- These zones imply the percentage of accidents or noise disturbance that could occur. Therefore it would be the best interest for people to be aware of them and to make changes that they see fit.

Mark Remsa, Director of Burlington Economic Development & Regional Planning, stated:
- These are guidelines; zoning establishes values of land, this process is supposed to help establish what is happening on bases. Local zoning is what gives a value to land, which gets complex with the addition of DEP wetlands and other state agencies regulations.

David McKeon, Director of Ocean County Planning Department, stated:
- Such as State Regulations, COAH, Sewer Regulations etc. The benefits of this study have been the close coordination with the state agencies, regional levels (the pinelands), and military. This is a special area and needs its own rules. The state agencies need to try to work with us (possibly bend) to understand that some current regulations will not work with this region. They may need to come up with new solutions/regulations. This will be an ongoing effort and we all need to work together.

Dan Glasson, DoD, OEA responded:
- DOD is willing to put up funding for areas where preservation is key. Will work with well-established County programs
- In 2008 the Pinelands, Counties, DEP, and DOD identified properties for acquisition and purchased them.
- Navy, Air Force, and Army still need partners for future acquisition.

Mark Remsa, Director of Burlington Economic Development & Regional Planning, stated:
- $1.2 million was spent for land acquisition/easements.
- Hopefully another $2 million to purchase land/easements will be coming in 2009.

David Hojsak, Senior Planner for Burlington Economic Development & Regional Planning, stated:
- Land acquisition mechanisms will be a recommendation.

Joseph Swartz, Fort Dix, stated:
- Joint Base needs sources of money to buy from existing property owners.

Rick Brown, NJDEP, asked:
- Will sound mitigation be recommended?

Brandi Bartolomeo, PS&S JLUS Project Manager stated:
- Yes sound mitigation will be included in the recommendations.
-

David McKeon, Director of Ocean County Planning Department, stated:
- Schools, Commercial Development, and TDR studies will be recommended with DoD funding sources as follow up studies.
- The Policy and Technical meeting groups will continue to work together even after the study wraps up to ensure that the recommendations are implemented.

Meeting Adjourned.

**Joint Land Use Study**
**7th Policy/Technical Committee Meeting**
**Plumsted Township Court Room**
**December 18, 2008, 3-5pm**
**Attendee List**

Anthony M. Agliata, Assistant Planning Director, Ocean County Planning Department
Michael Barboza, Noise Analyst, Paulus, Sokolowski, and Sartor, LLC
Brandi Bartolomeo, JLUS Project Manager, Paulus, Sokolowski, and Sartor, LLC
Dennis Blazak, Chief Environmental Engineer, Lakehurst Naval Air Engineering Station
Timothy Brill, Planning Manager, NJ State Agriculture Development Committee
Chester Broccoli, President of Planning Board, Plumsted Township
Rick Brown, Planner, NJDEP Office of Planning and Sustainable Communities
Daniel Burke, Township Engineer, Jackson Township
Gregory Bury, Geobase Manager, Lakehurst Naval Air Engineering Station
Scott Cadigan, GIS Specialist 1, Ocean County Planning Department
Pidge Carroll, District Director, Office of U.S. Congressman Christopher H. Smith
Richard Dean, Community Planner, McGuire Air Force Base
Daniel Glasson, Program Manager, US Department of Defense Office of Economic Adjustment
Bret Gordon, Program Manager, Sabre Systems Inc.
Stacy Grillo, Planner, NJDCA Office of Smart Growth
Robert Hardy, Plumsted Township Planning Board Member, Plumsted Township
Mark Hoffman, Noise Analyst, Paulus, Sokolowski, and Sartor
David Hojsak, Principal Planner, Burlington County Economic Development and Regional Planning
Sidney Hooper, Councilman, Lakehurst Borough
Daniel Kennedy, Farmland Preservation Coordinator, Burlington County Department of Resource Planning
Lt. Col Wayne McCaughey, NJ National Guard
David McKeon, Planning Director, Ocean County Planning Department
Elizabeth McLoughlin, Principal in Charge, Paulus, Sokolwski and Sartor, LLC
Charles Mink, Program Monitor, Sabre Systems, Inc.
Lou Mraw, Manager, NJDCA Division of Codes and Standards
Margit Myers, Presidential Management Fellow, US Department of Defense Office of Economic Adjustment
Daniel Patrick O'Connell, President, Evergreen Capital Advisors
John Olson, Planning Engineer, Lakehurst Naval Air Engineering Station
David Patriarca, Mayor, Pemberton Township
R. Eric Raaum, Senior Planning Engineer, Public Works Department, Lakehurst Naval Air Engineer Station
Michael Reina, Mayor, Jackson Township
Mark Remsa, Director, Burlington County Economic Development and Regional Planning
Edward Sain, Director of Installations, NJ Department of Military and Veterans Affairs
Joseph Schwartz, Environmental Specialist, DPW, Fort Dix Army Post
Roger Smith, Natural Resources Management Scientist, Environmental Natural Resources Office, Fort Dix Army
Peter Sobotka, Deputy Mayor, Springfield Township
Brian Sperling, Council President & Wrightstown MUA Operations Manager, Wrightstown Borough
Erika Stahl, Planner Trainee, Ocean County Planning Department
Diane Stinney, Council President & JLUS liaison for Township Council, Pemberton Township
Robert Turnbo, Air Field Operations, McGuire Air Force Base
Erik Waldrip, Community Planner, McGuire Air Force Base
Peter L. Ylvisaker, Executive Director, Main Street New Egypt, Plumsted Township

**Joint Base McGuire, Dix, Lakehurst**
**Joint Land Use Study**
**8th Policy Committee Meeting**
**Plumsted Township Municipal Building**
**March 10, 2009**

- Dave McKeon, Ocean Count Planning Director, convened meeting at 3:10 PM and introduced Colonel Gina Grosso, USAF, the new Commander of the 87th Air Base Wing and Joint Base McGuire Dix Lakehurst.
- Policy Committee Members introduced themselves for the new Commander
- Brandi Bartolomeo, PS&S JLUS Project Manager, presented a PowerPoint presentation that provided an overview of the JLUS Final Report, discussed sections 1 - 4 and introduced Bret Gordon to summarize the JLUS military analysis
- Bret Gordon, Sabre Systems, summarized the military analysis section, section 5, of the JLUS report.
- Brandi Bartolomeo presented sections 7- 9 of the report and introduced Candace Damon of HR&A Advisors, to present the economic component of the JLUS (section 10)
- Candace Damon, HR&A Advisors, presented the conclusion of the economic component of the JLUS
- Brandi Bartolomeo presented the identified issues brought up during the JLUS process and then discussed the recommended implementation strategies
- A Q&A session was held with participants. The following topics were mentioned and discussed.

  Rick Brown, NJDEP
  - Discussed the desire to see Joint Base noise studies to consider effects of real world noise, cloud cover, weather, etc

  Dave Hosak, Burlington County
  - Cell towers are issue but there is limited municipal authority to limit
  - Base notification for cell tower applications is important

  Mayor Patriarca, Pemberton Twp
  - Municipalities should be compensated for loss of potential revenue when limiting development in Transfer of Development Rights (TDR) programs
  - Can DoD OEA help funding or offer incentive programs for TDR in JLUS municipalities?
  - There is a small agriculture grant program

  Ed Fox, Burlington County
  - Important look at Dept of Agriculture, FHWA and other grant programs that may help fund some of the implementation of recommendations

  Tim Brill, NJ State Agricultural Development Committee
  - Add agricultural development areas to maps
  - Ocean County and Burlington County were just updated
  - Address trespass issues and permissive trespass

Dave Frank, Legal Counsel for New Hanover Twp and Wrightstown Borough
- The Joint Base should make it a priority to work through commercial competition and curtail on base competition

Mark Remsa, Burlington County
- Include next immediate steps in report
- It is an important step for both the JLUS municipalities and the Joint Base to implement the suggested charter and to develop the proposed procedures in the near term.

- Brandi Bartolomeo thanked the policy committee for their attendance and participation throughout the study.

- Dave McKeon announced that he JLUS Public Hearing would be held on March 30, 2009 at the New Egypt Primary School, Evergreen Road, Plumsted Twp, NJ and that a final Policy Committee meeting would be held at the end of April and hard copies of the final report would be distributed.

- The meeting was adjourned at 5:10 PM.

**Fort Dix/McGuire AFB/Lakehurst NAES**
**Attendees – Joint Land Use Study**
**8th Policy/ Technical Committee Meeting**
**Tuesday March 10, 2009**

Anthony M. Agliata, Assistant Planning Director, Ocean County Planning Dept.
Brandi Bartolomeo, JLUS Project Manager, Paulus, Sokolowski & Sartor, LLC
Gary Basham, Master Planner, Engineering Plans and Services Division, Fort Dix
Dennis Blazak, Chief Environmental Engineer, Lakehurst Naval Air Engineering Station
Timothy Brill, Planning Manager, NJ State Agriculture Development Committee
Rick Brown, Planner, NJ Department of Environmental Protection
Daniel Burke, Township Engineer, Jackson Township
Greg Bury, Environmental Engineer, Lakehurst Naval Air Engineering Station
Scott Cadigan, GIS Specialist I, Ocean County Planning Department
Candace Damon, Economic Analyst, HR&A
Richard T. Dean, Community Planner, McGuire Air Force Base
James Durr, Mayor, North Hanover Township
Ed Fox, Regional Planning Coordinator, Burlington County Economic and Regional Planning Dept.
David Frank, Councilman, Springfield Township
Daniel Glasson, Project Manager, US Department of Defense Office of Economic Adjustment
Bret Gordon, Program Manager, Sabre Systems, Inc.
Charlie Graziano, Field Representative, Office of US Congressman John H. Adler
Susan Grogan, Chief Planner, New Jersey Pinelands Commission
Colonel Gina Grosso, 87 Air Base Wing, Joint Base McGuire, Dix, Lakehurst Commander
Captian J.C. Harding, Executive Officer, Lakehurst Naval Air Engineering Station
Robert Hardy, Plumsted Twp. Planning Board member, Plumsted Township
Thomas E. Harper, Mayor, Wrightstown Borough
Matthew Harrison, Economic Analyst, HR&A
Mark Hoffman, Noise Analyst, Paulus, Sokolowski & Sartor, LLC
David J. Hojsak, Principal Planner, Burlington County Economic Development & Regional Planning Dept.
Sidney Hooper, Councilman, Lakehurst Borough
David J. McKeon, Planning Director, Ocean County Planning Department
Brian McPeak, Principal, Paulus, Sokolowki & Sartor, LLC
Charles E. Mink, Program Monitor, Sabre Systems, Inc.
Lou Mraw, Manager, NJ Dept. of Community Affairs Division of Codes and Standards
Margit Meyers, Presidential Management Fellow, US Department of Defense Office of Economic Adjustment
John Olson, Planning Engineer, Lakehurst Naval Air Engineering Station
David A. Patriarca, Mayor, Pemberton Township
Col. Mike Polhemus, Director of Staff, 87 ABW, Joint Base McGuire, Dix, Lakehurst
R. Eric Raaum, Senior Planning Engineer, Public Works Dept., Lakehurst Naval Air Engineering Station
Mark Remsa, Director, Burlington County Economic Dev. & Regional Planning
Jeff Sagnip, Congressional Aide, Office of US Congressman Christopher H. Smith, 4th District
Lt. Col (Ret) Edward R. Sain, Director of Installations, Department of Military and Veteran's Affairs
Joseph Schwartz, Environmental Specialist, DPW, Fort Dix
Brian Sperling, Council President, Wrightstown Borough
Roger Smith, Environmental Resources Office Branch Chief, Fort Dix
Peter Sobotka, Deputy Mayor, Springfield Township
Erika Stahl, Assistant Planner, Ocean County Planning Department
Diane P. Stinney, Council President, JLUS Liaison for Township Council, Pemberton Township
Erik Waldrip, Community Planner, 87 CES, Joint Base McGuire, Dix, Lakehurst
Lorissa Whitaker, Principal Planner, NJ Dept. of Community Affairs Office of Smart Growth
Peter L. Ylvisaker, Executive Director, Main Street New Egypt, Plumsted Township

## Section 13.4 - Noise Basics

**Sound** Sound is generated when a vibrating object (sound source) creates a physical disturbance that sets the parcels of air or other surrounding medium nearest to it in motion, causing pressure variations that form a series of alternating compression and expansion pressure waves that move or propagate outward away from the source usually in a spherical pattern. Factors that affect how sound is perceived by the human ear include the amplitude or loudness, the frequency, and the duration of the sound, as well as the location of the receiver relative to the source of sound. The sound levels we encounter in daily life vary over wide ranges of these factors.

**Decibel (dB)** The standard metric for noise is the decibel (dB). The lowest sound pressure level the ear can detect (a soft whisper) is more than a million times less than that of a jet engine. To make this large range of values more meaningful, an adaptation of a logarithmic mathematical scale is used (i.e., the dB scale). On the dB scale, the range of human hearing is represented at the lowest audible level by 20 dB and at the maximum level, or threshold of pain, at approximately 140 dB.

The decibel is used as a unit of sound amplitude or loudness and is derived from a comparison sound pressure, in air, with a reference pressure. Broadband sound covers the whole of the audible frequency range and is made up of many tones. Figure 13.4-1 equates decibel levels with the sound of everyday activities.

Noise The terms “sound” and “noise” are often used synonymously. Noise is unwanted sound usually composed of a spectrum of many single frequency components, each having its own amplitude. The disturbing effects of noise depend both on the intensity and the frequency of the tones. For example, higher frequencies are often more disturbing than low frequencies. Pure tones can be more disturbing than broadband sound. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies. Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying.

**Frequency** The normal human ear can detect sounds that range in frequency from about 20 cycles per second (Hz) to 15,000 Hz. However, all sounds throughout this range are not heard equally well. Low-frequency sounds are heard as “rumbles,” and high-frequency sounds are heard as “screeches.”

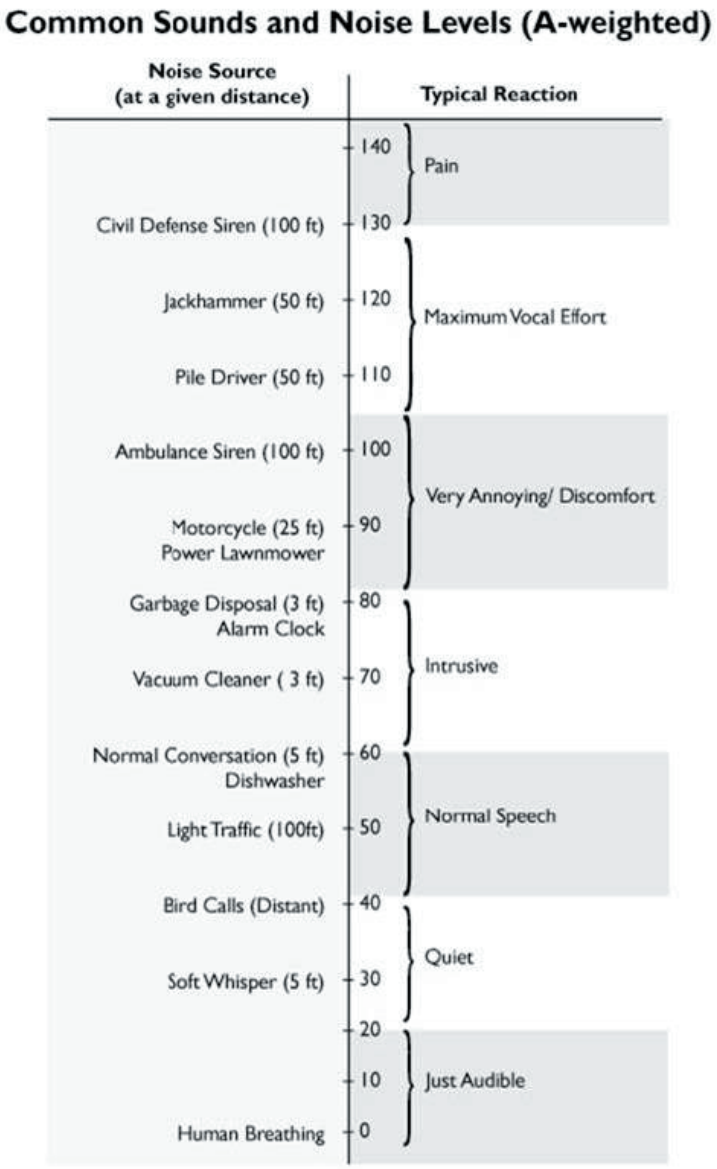
Noise with distinct tones can be more noticeable and often more disturbing than other types of noise, for example, noise from fans, compressors, or power saws. There are different frequency-weighting systems related to the type of noise source.

**A-Weighting (dBA)** Noise measurements are often taken using the “A-weighted” frequency response function. The A-weighted frequency or dBA scale simulates the response of the human ear to sound levels (particularly low-level sound) and has been given prominence as a means for estimating annoyance caused by noise, for estimating the magnitude of noise-induced hearing damage, in hearing conservation criteria, for speech interference measurements, and in procedures for estimating community reaction to (general broad band) noise (Clayton, et al. 1978; Cheremisinoff, et al. 1977). Sound measurements are often made using the “A” frequency weighting when assessing environmental noise.

A-weighting measures noise that closely resembles the frequency response of human hearing, including response to high-frequency noise. A-weighting, expressed as dBA, is a good descriptor of higher frequency noise caused by small arms firing, aircraft use, and vehicle operations. Further, small arms are also characterized in terms of peak un-weighted dB level.

**C-Weighting (dBC)** C-weighting measures the low-frequency component of noise, which can cause buildings and windows to shake and rattle. C-weighted sound level measurement (dBC) correlates well with physical vibration response of buildings and other structures to airborne sound. Impulsive noise resulting from armor, artillery, and demolition activities are assessed in terms of dBC; C-weighting shows the low frequency noise and vibration associated with the firing of larger weapons systems. When measuring sound with a large low-frequency component, values measured using the C-scale are usually higher than values measured using the A-scale.

**Noise Descriptors** There are a number of noise descriptors used to characterize various aspects of noise that take into account the variability of noise levels over time which most environments experience. Commonly used descriptors applicable to different situations are discussed below.




**Equivalent Sound Level (Leq)** The equivalent sound level (Leq) is the value of a steady-state sound which has the same sound energy as that contained in the time-varying sound. The Leq is a single sound level value for a desired duration, which includes all of the time-varying sound energy occurring during the measurement period. The U.S. EPA has selected Leq as the best environmental noise descriptor for several reasons, but primarily because it correlates reasonably well with the effects of noise on people, even for wide variations of environmental sound levels and different time exposure patterns. Also, equipment is available to measure and compute the Leq.

**Statistical Descriptors** Statistical sound level descriptors such as L1, L10, L50, and L90 are used to represent noise levels that are exceeded 1, 10, 50, and 90 percent of the time, respectively. L50, the Sound Pressure Level (SPL) exceeded 50 percent of the time, provides an indication of the median sound level. L90 represents the residual level, or the background noise level without intrusive noises. The Lmax represents the maximum sound level recorded, and the Lmin represents the lowest sound level recorded over a specific time interval (i.e., 1-hour, 24-hour monitoring periods).

**Peak Sound Level** Peak sound level is the maximum instantaneous sound level of an event measured with a sound level meter or analyzer set for un-weighted (or linear weighting). No time integrating is used when peak levels are measured.

**Ambient (Residual) Noise Level** Ambient noise is the combined noise from all noise generating sources (factory noise, traffic noise, birdsong, running water, etc.). The ambient noise is composed of the noise contributions from specific noise sources.

Residual or background sound level can be useful in characterizing a community with respect to noise. The residual sound level is the minimum sound level in the absence of identifiable or intermittent local sources. It is not the absolute minimum sound level during a long observation period, but rather the lowest reading that is reached repeatedly during a given period. The L90 (referred to as the ambient level) is a statistical descriptor, which represents the level that is exceeded 90 percent of the time. Comparisons of data have shown that the L90, measured with a continuous statistical sound meter, and the residual sound level, measured by trained personnel with a sound-level meter, are closely correlated with one another (Bolt, Beranek, and Neman, Inc. 1978).

**Day/Night Equivalent Sound Level (DNL)** The day/night equivalent sound level (DNL) or (Ldn) is the equivalent energy-averaged sound level for a 24-hour period (U.S. EPA 1974). The Ldn is estimated from the equivalent daytime Ld (7:00 a.m. to 10:00 p.m.) and nighttime Ln (10:00 p.m. and 7:00 a.m.) levels with an additional 10 dBA weighting imposed on the equivalent sound levels occurring during nighttime (10:00 p.m. and 7:00 a.m.). The 10-decibel increase at night is because people are more sensitive to noise during normal sleeping hours, when ambient noise levels are lower.

The U.S. EPA suggests this descriptor be used to relate noise in residential areas to annoyance caused by interference with speech, sleep and other activity. Based on interpretation of available scientific information, U.S. EPA identified an outdoor Ldn of 55 dBA as a level protective of public health and welfare with an adequate margin of safety, without concern for economic and technical feasibility (U.S. EPA 1978).

The DNL provides a single measure of overall noise impact and represents total sound exposure. Although DNL does provide a single measure of overall noise impact, it does not provide specific information on the number of noise events or specific individual sound levels that occur. For example, a DNL of 65 dB could result from a small number of very loud events or from a large number of quieter events. Although it does not represent the sound level heard at any one particular time, it does represent total sound exposure. Scientific studies and social surveys have found DNL to be the best measure for assessing levels of annoyance associated with all types of environmental noise. Therefore, the scientific community and governmental agencies, such as US EPA, the Federal Interagency Committee on Urban Noise (FICUN), and the Federal Interagency Committee on Noise (FICON), endorse its use. DNL is the preferred noise metric of the US EPA, HUD, FAA, and DOD.

DNL can be assessed using the A-weighted scale or C-weighted scale. The A-weighted Day-Night Average Sound Level (ADNL) noise descriptor is used to describe the noise environment around airfields; DNL has been determined to be a reliable measure of community sensitivity to aircraft noise and has become the standard metric used in the U.S. to quantify aircraft noise. The C-weighted Day-Night Average Sound Level (CDNL) is used for intense noise containing low frequency sound energy (near or below the threshold of human hearing) like that from large gun blasts and sonic booms that tend to elicit annoyance through building rattles.

**Sensitive Receptors** Human response to increased sound levels varies according to the source type, characteristics of the sound source, distance between source and receptor, receptor sensitivity, and time of day. Areas or receptors that are considered potentially sensitive to noise include residences, schools, hospitals, and recreational facilities (U.S. Environmental Protection Agency, 1974). Potentially sensitive receptors located near the noise source usually include residential areas near the site. The location of closest residence to the noise source is identified and is commonly a candidate for noise monitoring. Affected receptors are specific (e.g., schools, churches, or hospitals) or broad (e.g., nature preserves or designated districts) areas in which occasional or persistent sensitivity to noise above ambient levels exists and existing background levels.

**Noise Guidelines and Standards** Federal and local governments have established noise guidelines and regulations for the purpose of protecting citizens from potential hearing damage and from various other adverse physiological, psychological, and social effects associated with noise. Chapter 7 of Department of the Army Regulation (AR) 200-1 implements all Federal laws concerning environmental noise from Department of the Army activities. According to AR 200-1, the objectives of noise abatement are to:

- Assess the environmental impacts from noise produced by military activities and to mitigate harmful or objectionable effects to the maximum extent possible
- Comply with applicable Federal, state, interstate, and local standards pertaining to noise consistent with military requirements
- Achieve noise abatement through the application of engineering noise control measures, modern land use planning, and procurement of low-noise emission products
- Incorporate noise control provisions as necessary.

**USEPA** The U.S. EPA suggests the DNL be used to relate noise in residential areas to annoyance caused by interference with speech, sleep and other activity. Based on interpretation of available scientific information, U.S. EPA identified an outdoor DNL of 55 dBA as a level protective of public health and welfare with an adequate margin of safety, without concern for economic and technical feasibility (U.S. EPA 1978).

The US EPA has examined levels of environmental noise necessary to protect public health and welfare, and on speech communication and indoor interference (U.S. EPA 1978) and indicates that "the highest noise level that permits relaxed conversation with 100% sentence intelligibility throughout a room is an indoor DNL of 45 dBA." An indoor sound-level of 55 dBA corresponds to 99% sentence intelligibility and an indoor sound-level of about 65 dBA corresponds to 95% sentence intelligibility. These sound-levels are guidance levels developed by US EPA without concern for economic and technological feasibility and are intentionally conservative. An indoor DNL of 45 dBA or lower is the preferred level of the US EPA for assessing indoor noise exposure.

**HUD Circular 1390.2** The U.S. Department of Housing and Urban Development (HUD) is a federal agency established in 1965 by the Department of Housing and Urban Development Act. HUD's mission is to increase homeownership, support community development and increase access to affordable housing free from discrimination.

HUD was tasked by the Housing and Urban Development Act of 1965 (Public Law 89-117) "to determine feasible methods of reducing the economic loss and hardships suffered by homeowners as a result of the depreciation in the value of their properties following the construction of airports in the vicinity of their homes. The Noise Control Act of 1972, in addition to its specific tasking to EPA, tasked all Federal agencies to administer their programs in ways which to reduce noise pollution. Finally, the Department is tasked by Federal Management Circular 75-2: Compatible Land Uses at Federal Airfields to make sure that its actions do not promote incompatible land uses around Federal airfields (U.S. Department of Housing and Urban Development, 2002).

HUD has the responsibility to be aware of potential noise problems and potential noise impacts on HUD housing environments. HUD Regulations set forth the following exterior noise standards for new housing construction: 65 Ldn or less is acceptable, exceeding 65 Ldn but not exceeding 75 Ldn is normally unacceptable, and exceeding 75 Ldn is unacceptable. Approvals of mortgage loans from HUD or the Department of Veterans Affairs are subject to HUD requirements (circular) that sets forth a discretionary policy to withhold funds for housing projects when noise exposure levels are in excess of prescribed levels. HUD funding for residential housing may be permitted in areas with outdoor ADNL of 65, provided sound insulation is accomplished. Insulation, however, may make development in these areas financially less attractive. Because the HUD policy is discretionary, variances may also be permitted, depending on regional interpretation and local conditions.

HUD also has a policy which does not provide funding for projects in clear zones and accident potential zones unless the project is compatible with the AICUZ (24 CFR Section 51.300).

**GSA Federal Management Circular 75-2** GSA requires agencies sponsoring federally funded projects to ensure that these projects are compatible with land use plans of the airport operator. This circular allows the aircraft installation to extend its land use recommendations to federally funded projects in the vicinity.

**FICUN** In the late 1970's, several federal agencies, including the DOD, came together to establish the Federal Interagency Council on Urban Noise (FICUN) with the purpose of creating a consistent set of guidelines for determining the total noise impact on communities. Many of the current DOD land use compatibility guidelines were adopted as the method to determine noise impacts on these communities and FICUN published these guidelines in a 1980 report (FICUN 1980).

In response to citizen concerns in the late 1980's and the need for interagency coordination, the federal agencies came together for two purposes. The first was to reassess the EPA's method of determining noise and the second reason was to establish the impact criteria from noise sources. To signify this broader mandate, the agencies changed their name to the Federal Interagency Committee on Noise (FICON) and in their report they reconfirmed the basic noise measurement standards as applicable for noise analysis (FICON 1992). At the same time, FICON also established a curve for assessing the impact of noise on sleep disturbance and established thresholds for judging significant impacts.

In 1993, FICON came together again, this time to concentrate on aviation noise. The Federal Interagency Committee on Aviation Noise (FICAN) was formed to provide forums for debate over the need for future aviation noise research and to encourage new development efforts in this area.

The Federal Interagency Committee on Urban Noise (FICUN) developed land use compatibility guidelines for noise exposure areas (FICUN 1980). FICUN developed guidelines for considering noise in land use planning in terms of a DNL sound level (FICUN, 1980).

DNL is the accepted unit for quantifying annoyance to humans from general environmental noise, including aircraft noise. Most people are exposed to sound levels of 50 to 55 dBA or higher on a daily basis. Studies specifically conducted to determine noise impacts on various human activities show that about 90 percent of the population is not significantly bothered by outdoor sound levels below 65 dBA (USDOT 1984). Studies of community annoyance in response to numerous types of environmental noise show that ADNL correlates well with impact assessments and that there is a consistent relationship between ADNL and the level of annoyance.

Based upon these FICUN guidelines, the FAA developed recommended land uses in aircraft noise exposure areas. These guidelines provide for assessing land uses related to noise zones based on USAF, FAA and HUD criteria. According to the USAF, the FAA, and the HUD criteria, residential units and other noise-sensitive land uses are “clearly unacceptable” in areas where the noise exposure exceeds 75 dBA; “normally unacceptable” in regions exposed to noise between 65 dBA and 75 dBA; and “normally acceptable” in areas exposed to noise of 65 dBA or under. For outdoor activities, the USEPA recommends a DNL sound level of 55 dBA as the sound level below which there is no reason to suspect that the general population would be at risk from any of the effects of noise (USEPA 1974).

The Air Force uses DNL as the method to estimate the amount of exposure to aircraft noise and predict impacts as recommended by FICUN. Land use compatibility and incompatibility are determined by comparing the predicted DNL level at a site with the recommended land uses.

**AICUZ and IONMP** Ongoing DOD programs provide for studies to assess potential noise levels generated and air safety concerns associated with various training operations and to identify off-base land areas around military installations (i.e., airfields, ranges), with zoning and/or land use that may be incompatible with the noise levels and aircraft accident potential. This information provides a basis to develop recommendations for the land lying within these areas that are compatible with the needs of the community and the base missions.

The Air Installation Compatibility Use Zone Program (AICUZ) is an ongoing program for all Air Force airfields. It is designed to assist the adjacent community by recommending land use planning that ensures safe aircraft operations and minimizes noise impacts to the community. AICUZ program experience indicates that future year planning is necessary to consider the effects of expected changes in mission, aircraft, operational levels, etc. One element of the AICUZ program is to develop noise contours around the base that can be used by the community for zoning ordinances.

The Army Installation Compatible Use Zone (ICUZ) program is similar to the AICUZ program for air operations. ICUZ provides a method for evaluating the effect of noise and the hazards associated with training operations that stem from activities at military installations such as ranges. The ICUZ program considers the land areas, with noise-sensitive land uses, that are exposed to generally unacceptable noise levels and aircraft accident potential.

The policy and procedures of the ICUZ are essentially the same as the AICUZ. The ICUZ has recently been incorporated into the IONMP to emphasize actions other than zoning (i.e., ordinances, regulation of new construction, etc.) as solutions to planning in the noise environment.

With the IONMP, the primary strategies for protecting the mission of military installations from the problems of noise incompatibility are long-range land use planning and being a responsible neighbor to surrounding communities.

Central to these programs is noise modeling that creates noise contours against which the land use compatibility designations are overlaid. As part of the Installation Operational Noise Management Plan (IONMP) the ICUZ study, the key tool to identifying and avoiding potential noise problems at an installation, is essentially a planning document.

The purpose of the IONMP is to:

- Control environmental noise to protect the health and welfare of people, on and off-base, who are impacted by military installation authorized noise producers
- Reduce community annoyance from environmental noise to the extent feasible
- Actively engage local communities in land use planning in areas subject to high levels of operational noise with a high potential for noise complaints

An Installation Operational Noise Management Program (IONMP) Report is the main component of noise abatement planning and is an essential tool for finding common ground with neighboring communities. It is an installation-specific study of the existing and future noise environment, developed to aid military and civilian officials and planners in creating land-use plans and policies that promote compatibility between the needs of the civilian sector and the installation's mission requirements.

The IONMP not only examines current activities on the installation, but also considers the impacts of future weapons and missions. The IONMP process attempts to take immediate steps to prevent land compatibility conflicts from occurring or at least to minimize their impacts. The purpose of the program is to identify land areas that are exposed to generally unacceptable noise levels and aircraft accident potential. This information is then used to recommend uses for the land lying within these areas that are compatible with the needs of the civilian community and the Army.

AICUZ and IONMP information was provided to the Team for current and forecasted operations from previous studies and documents by others and included noise contours from detailed computerized simulation modeling for AICUZ /IONMP.

AICUZ /IONMP noise studies define noise level contours that reflect noise associated with air operations and other activities at the base. Boundaries of the AICUZ Study Area (ASA) are based on the existing community planning or jurisdictional boundaries of local municipalities located nearby.

**AICUZ Projected Operations** AICUZ contours are developed to reflect the normalized operating conditions of any new rotary and fixed-wing aircraft to accommodate the safe co-location of the military installation and the surrounding community development.

Therefore, in addition to the baseline year analysis, the AICUZ includes an analysis of future mission requirements (projected operations). The resultant noise contours are referred to as the "projected" noise contours. Projections of aircraft and aircraft operations are based upon currently available unclassified estimates of future mission requirements.

Projections of air operations activity levels (normally for a time frame 5 to 10 years forward) are needed to assess changes in air installation activity levels and/or operational procedures. The noise effects of a given or forecast of air operations can be assessed by a measure of the amount of land area associated with various DNL noise contours (for example of 65 dB). Relative increases or decreases of areas within various DNL contour levels for the various land uses and populations within these areas can also be assessed and related to different air or other operations.

**Noise Modeling** Computer models are used to simulate resulting noise levels from various operational activities (aircraft operations, small arms use, large arms use, etc.). Noise contours are developed by a computerized simulation model of munitions and/or aircraft activity at an installation that reflect noise from site-specific operational data; e.g., type of training, type of weapons used, flight tracks, type and mix of aircraft, aircraft profiles (airspeed, altitude, power settings), frequency and times of operations at a given base and meteorology. This operational information is used to calculate values (noise levels) at points on a regularly spaced grid surrounding a base. A plotting program generates contour lines connecting points of equal values in a manner similar to elevation contours shown on topographic maps. Noise levels from various operations are represented by noise contours.

The contours around the installation reflect either the peak sound level, or an average day-night sound level (DNL) that converts noise varying from peak bursts to relative quiet into a steady measure of acoustic energy over a 24 hour period. The DNL can be assessed using the A-weighted scale or C-weighted scale. The A-weighted Day-Night Average Sound Level (ADNL) noise descriptor is used to describe the noise environment around airfields or for small arms munitions use. The C-weighted Day-Night Average Sound Level (CDNL) is used for intense noise containing low frequency sound energy like that from large arms munitions use.

Noise levels (Peak or DNL) are depicted as contours connecting points of equal value, usually in 5-decibel increments. Calculated noise contours do not represent exact scientific noise measurements; noise levels inside a contour may be similar to those outside a contour line. The area between two specific sets of contours is known as a noise zone. Contours that define noise zones should be viewed as a planning tool, not as a series of discrete lines that sharply divide noise-affected land from non-noise affected areas.

U.S. Department of Defense (DOD) approved noise models were used to define the noise zones for Fort Dix munitions use. Small Arms Range Noise Assessment Model (SARNAM) was used to generate noise contours from small arms activity (munitions less than 20 millimeters), and Blast Noise (BNOISE2) was used to generate noise contours from the artillery and demolition firing (munitions greater than 20 millimeters). Noise levels associated with civilian and military vehicle operations were determined using Federal Highway Administration Traffic Noise Model (FHWA TNM).

The noise analysis methods used for airfield operations at McGuire AFB and NAES Lakehurst are based on the noise contours produced by the NOISEMAP noise model (AMC EA, 2005). NOISEMAP is a suite of computer programs developed by the Air Force to predict noise exposure in the vicinity of an airfield due to aircraft flight, maintenance, and ground run-up operations.

The contours produced by NOISEMAP, SARNAM and BNOISE2 were developed as part of previous studies related to operations and analyses of potential environmental impact assessments compiled for the three military installations. These contours have been compiled, reviewed, extracted and summarized in the noise analysis sections from available previously prepared documents, and other

## Section 13.5 - Guideline for Considering Noise in Land Use Planning and Control

(FICUN 1980)

| | NZ I | | NZ II | | NZ III | | |
|---|---|---|---|---|---|---|---|
| | 0-55 | 55-65 | 65-70 | 70-75 | 75-80 | 80-85 | 85+ |
| **RESIDENTIAL** | | | | | | | |
| Household Units | Yes | Yes* | 25[1] | 30[1] | No | No | No |
| Group Quarters | Yes | Yes* | 25[1] | 30[1] | No | No | No |
| Residential Hotels | Yes | Yes* | 25[1] | 30[1] | No | No | No |
| Manufactured Housing | Yes | Yes* | No | No | No | No | No |
| Other Residential | Yes | Yes* | 25[1] | 30[1] | No | No | No |
| **MANUFACTURING** | | | | | | | |
| Food Products | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Textile Mill Products | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Apparel | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Wood Products | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Furniture | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Paper | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Printing | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Manufacturing | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| **TRANSPORT, COMMS & UTIL** | | | | | | | |
| Railroad | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Motor Vehicle | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Aircraft | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Marine Craft | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Highway & Street | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Parking | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Communications | Yes | Yes | Yes | 25[5] | 30[5] | No | No |
| Utilities | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[4] |
| Other T, C & U | Yes | Yes | Yes | 25[5] | 30[5] | No | No |
| **TRADE** | | | | | | | |
| Wholesale Trade | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Retail - Building | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |

| | NZ I | | NZ II | | NZ III | | |
|---|---|---|---|---|---|---|---|
| | 0-55 | 55-65 | 65-70 | 70-75 | 75-80 | 80-85 | 85+ |
| Retail - General | Yes | Yes | Yes | 25 | 30 | No | No |
| Retail - Food | Yes | Yes | Yes | 25 | 30 | No | No |
| Retail - Auto | Yes | Yes | Yes | 25 | 30 | No | No |
| Retail - Apparel | Yes | Yes | Yes | 25 | 30 | No | No |
| Retail - Furniture | Yes | Yes | Yes | 25 | 30 | No | No |
| Retail - Eating | Yes | Yes | Yes | 25 | 30 | No | No |
| Other Retail Trade | Yes | Yes | Yes | 25 | 30 | No | No |
| **SERVICES** | | | | | | | |
| Finance, Insurance | Yes | Yes | Yes | 25 | 30 | No | No |
| Personal Services | Yes | Yes | Yes | 25 | 30 | No | No |
| Cemeteries[11] | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | Yes[6] |
| Repair Services | Yes | Yes | Yes | Yes[2] | Yes[3] | Yes[4] | No |
| Profess Services | Yes | Yes | Yes | 25 | 30 | No | No |
| Hospitals, Nursing | Yes | Yes* | 25* | 30* | No | No | No |
| Other Medical Facilities | Yes | Yes | Yes | 25 | 30 | No | No |
| Contract Construction | Yes | Yes | Yes | 25 | 30 | No | No |
| Government Services | Yes | Yes* | Yes* | 25* | 30* | No | No |
| Educational Services | Yes | Yes* | 25* | 30* | No | No | No |
| Misc Services | Yes | Yes | Yes | 25 | 30 | No | No |
| **CULTURAL, ENTERTAINMENT & REC** | | | | | | | |
| Churches | Yes | Yes* | 25* | 30* | No | No | No |
| Nature Exhibits | Yes | Yes* | Yes* | No | No | No | No |
| Public Assembly | Yes | Yes | Yes | No | No | No | No |
| Auditoriums | Yes | Yes | 25 | 30 | No | No | No |
| Amphitheaters | Yes | Yes* | No | No | No | No | No |
| Outdoor Sports | Yes | Yes | Yes[7] | Yes[7] | No | No | No |
| Amusements | Yes | Yes | Yes | Yes | No | No | No |
| Recreational | Yes | Yes* | Yes* | 25* | 30* | No | No |
| Resorts | Yes | Yes* | Yes* | Yes* | No | No | No |
| Parks | Yes | Yes* | Yes* | Yes* | No | No | No |
| Other | Yes | Yes* | Yes* | Yes* | No | No | No |

| | NZ I | | NZ II | | NZ III | | |
|---|---|---|---|---|---|---|---|
| | 0-55 | 55-65 | 65-70 | 70-75 | 75-80 | 80-85 | 85+ |
| **RESOURCE PRODUCT** | | | | | | | |
| Agriculture | Yes | Yes | Yes[8] | Yes[9] | Yes[10] | Yes[10] | Yes[10] |
| Livestock | Yes | Yes | Yes[8] | Yes[9] | No | No | No |
| Forestry | Yes | Yes | Yes[8] | Yes[9] | Yes[10] | Yes[10] | Yes[10] |
| Fishing | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mining | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Other Resource | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**Legend:**

| | |
|---|---|
| Yes | Land use and related structures compatible without restrictions |
| No | Land use and related structures are not compatible and should be prohibited |
| ADNL | A-weighted day-night sound level |
| NZ | Noise Zone |
| Yesx | (Yes with restrictions) Land use and related structures generally compatible |
| 25, 30, 35 | Land use and related structures generally compatible; measures to achieve noise level reduction (NLR) of 25, 30 or 35 must be incorporated into design and construction of structure |
| 25*, 30*, 35* | Land use generally compatible with NLR; however, measures to achieve an overall NLR do not necessarily solve noise difficulties; additional evaluation is warranted |
| NLR | Noise level reduction (outdoor to indoor) is to be achieved through incorporation of noise attenuation into the design and construction of the structure. |

**Notes:**

1(a) Local conditions may require residential use, however it is discouraged in 65-70 ADNL and strongly discouraged in 70-75 ADNL. The absence of viable alternative development options should be determined and an evaluation, indicating that a demonstrated community need for residential use would not be met if development were prohibited in these Zones, should be conducted prior to approvals.

1(b) Where the community determines that residential uses must be allowed, measures to achieve an outdoor to indoor NLR of at least 25 dB (65-70 ADNL) and 30 dB (70-75 ADNL) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation, upgraded Sound Transmission Class (STC) ratings in windows and doors, and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels or vibrations.

1(c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design, and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level sources. Measures that reduce noise at a site should be used wherever practical in preference to measures that only protect interior spaces.

2 Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

3 Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

4 Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

5 If noise-sensitive, use indicated NLR; if not, use is compatible.

6 No buildings.

7 Land use compatible provided special sound reinforcement systems are installed.

8 Residential buildings require a NLR of 25.

9 Residential buildings require a NLR of 30.

10 Residential buildings not permitted.

11 In areas with ADNL greater than 80, land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

# Section 13.6 - DoD Compatible Land Use Guidelines

For Clear Zones And Accident Potential Zones (APZ)
(U.S. Army 1981)

| Land Use | Clear Zone | APZ I | APZ II |
|---|---|---|---|
| **RESIDENTIAL** | | | |
| Single Family Unit | No | No | Yes[2] |
| 2-4 Family Units | No | No | No |
| Multifamily Dwellings (Apartments) | No | No | No |
| Group Quarters | No | No | No |
| Residential Hotels | No | No | No |
| Mobile Home Parks or Courts | No | No | No |
| Other Residential | No | No | No |
| **INDUSTRIAL & MANUFACTURING[3]** | | | |
| Food and Kindred Products | No | No | Yes |
| Apparel | No | No | No |
| Lumber and Wood Products | No | Yes | Yes |
| Furniture and Fixtures | No | Yes | Yes |
| Printing, Publishing | No | Yes | Yes |
| Miscellaneous Manufacturing | No | Yes | Yes |
| **TRANSPORTATION, COMMUNICATIONS & UTILITIES[4]** | | | |
| Railroad, Rapid Rail Transit (on-grade) | No | Yes[4] | Yes |
| Highway and Street Rights-of-Way | Yes[5] | Yes | Yes |
| Auto Parking | No | Yes | Yes |
| Communications | Yes[5] | Yes | Yes |
| Utilities | Yes[5] | Yes[4] | Yes |
| Other Transportation, Communications and Utilities | Yes[5] | Yes | Yes |
| **COMMERCIAL & RETAIL TRADE** | | | |
| Wholesale Trade | No | Yes | Yes |
| Building Materials (Retail) | No | Yes | Yes |
| General Merchandise (Retail) | No | No | Yes |
| Food (Retail) | No | No | Yes |
| Automotive, Marine, and Aviation | No | Yes | Yes |
| Apparel and Accessories (Retail) | No | No | Yes |
| Furniture, Home Furnishings (Retail) | No | No | Yes |
| Eating and Drinking Facilities | No | No | No |
| Other Retail Trade | No | No | Yes |
| **PERSONAL & BUSINESS SERVICES[6]** | | | |
| Finance, Insurance, and Real Estate | No | No | Yes |
| Personal Services | No | No | Yes |
| Business Services | No | No | Yes |
| Repair Services | No | Yes | Yes |
| Professional Services | No | No | Yes |
| Contract Construction Services | No | Yes | Yes |
| Indoor Recreation Services | No | No | Yes |
| Other Services | No | No | Yes |
| **PUBLIC AND QUASI-PUBLIC SERVICES** | | | |
| Government Services | No | No | Yes6 |
| Educational Services | No | No | No |
| Cultural Activities | No | No | No |
| Medical and Other Health Services | No | No | No |
| Cemeteries | No | Yes[7] | Yes[7] |
| Non-profit Organizations including Churches | No | No | No |
| Other Public and Quasi-Public Services | No | No | Yes |
| **OUTDOOR RECREATION** | | | |
| Playgrounds and Neighborhood Parks | No | No | Yes |
| Community and Regional Parks | No | Yes[8] | Yes[8] |
| Nature Exhibits | No | Yes | Yes |
| Spectator Sports Including Arenas | No | No | No |
| Golf Courses[9], Riding Stables[10] | No | Yes | Yes |
| Water Based Recreational Areas | No | Yes | Yes |
| Resort and Group Camps | No | No | No |

| Land Use | Clear Zone | APZ I | APZ II |
|---|---|---|---|
| Entertainment Assembly Areas | No | No | No |
| Other Outdoor Recreation | No | Yes[8] | Yes |
| **RESOURCE PRODUCTION & EXTRACTION& OPEN LAND** | | | |
| Agriculture[11] | Yes | Yes | Yes |
| Livestock Farming, Animal Breeding[12] | No | Yes | Yes |
| Forestry Activities | No | Yes | Yes |
| Fishing Activities and Related Services[13] | No[14] | Yes[13] | Yes |
| Mining Activities | No | Yes | Yes |
| Permanent Open Space | Yes | Yes | Yes |
| Water Areas[13] | Yes | Yes | Yes |

**Notes:**

1A "Yes" or "No" designation for compatible land use is to be used only for gross comparison. Within each, uses exist where further definition may be needed as to whether it is clear or usually acceptable/unacceptable owing to variations in densities of people and structures. For heliports and stagefields, the takeoff safety zone is equivalent to the clear zone and the approach-departure zone is equivalent to APZ I for these land use guidelines.

2 Suggested maximum density 1-2 dwelling units per acre, possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent.

3 Factors to be considered: Labor intensity, structural coverage, explosive characteristics, and air pollution.

4 No passenger terminals and no major above ground transmission lines in APZ I.

5 Not permitted in graded area.

6 Low intensity office uses only. Meeting places, auditoriums, etc., not recommended.

7 Excludes chapels.

8 Facilities must be low intensity.

9 Clubhouse not recommended.

10 Concentrated rings with large classes not recommended.

11 Includes livestock grazing but excludes feedlots and intensive animal husbandry.

12 Includes feedlots and intensive animal husbandry.

13 Includes hunting and fishing.

14 Controlled hunting and fishing may be permitted for the purpose of wildlife control.

# Section 13.7 - New Construction Acoustical Design Guide

**Prepared for MCAS Cherry Point by Wyle Laboratories (WR 04-28 December 2004)**

Wyle Report

WR 04-28

(J/N 51503)

Revised 23 December 2004

FINAL

**NEW CONSTRUCTION ACOUSTICAL DESIGN GUIDE**

*Prepared for*

MCAS Cherry Point

*Prepared by*

Gary Ehrlich

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# 1.0 Introduction

## 1.1 Background

Residences located near military airfields experience many economic and transportation benefits of the facility, but are unfortunately exposed to significant amounts of aircraft noise. However, using proper construction techniques and materials minimizes the impact of aircraft noise and reduces interference with regular indoor activities. This New Construction Acoustical Design Guide can assist in incorporating specific noise level reduction features into the designs of new homes in the Marine Corps Air Station (MCAS) Cherry Point area. These features will help to ensure that new homes in the area provide an adequate noise level reduction to protect occupants from undesirable noise impacts.

For homes located in areas with high noise levels, standard building methods, even those that are designed for thermal efficiency, are normally inadequate to protect inhabitants from external noise. For this reason, building design and construction methods may have to be modified for noise-sensitive rooms such as bedrooms, kitchens, living rooms, and family rooms. These spaces are referred to as the habitable rooms in a house. Standard design and construction methods can typically be used for non-habitable rooms, such as garages, mudrooms, and breezeways unless they open directly to habitable rooms without interior doors in between the rooms.

This Design Guide provides recommendations for the design of dwellings in the vicinity of the airfield that may be constructed in the future. It is meant to be used in conjunction with noise overlay zones developed by the surrounding communities through the joint land use study process. This Guide was developed for new homes; different materials and techniques would be appropriate when renovating houses to achieve the noise level reduction goals. Construction guidelines are presented for the noise level reductions (NLRs) of 20, 25, 30, and 35 decibels. Noise levels typically vary somewhat throughout a room. Throughout this guide the NLR is considered for locations approximately six feet from exterior walls.

The recommendations contained in this Guide were developed considering the unique characteristics of the aircraft that currently use MCAS Cherry Point. As a result, the recommendations would not be the same as those developed for communities near civilian airfields.

## 1.2 How to Use this Guide

This guide has been developed to be used by a variety of different professionals, as well as by interested homeowners. This guide is recommended for the following people:

- Planning Officials
- Plan Reviewers
- Building Inspectors
- Builders
- Homebuyers/Homeowners

*Sections 2.0 Through 3.0*

The main design guide sections include a brief overview of sound transmission paths into a home, a discussion of basic design principles, and subsections for each building element including windows, doors, walls, ceilings and roofs, floors and crawlspaces, and mechanical systems. The building element subsections include text, tables, and design detail drawings to illustrate various options for noise control. Cost estimates are included for the proposed upgrades.

*Section 4.0*

Specific design requirements are presented in a selection chart. Designs that achieve noise level reductions (NLR) of 20, 25, 30 and 35 dB are listed. The table in Section 4.0 tells the sound ratings of building materials that are needed to achieve the NLR design goals. Additional details are provided in Appendix A.

*Section 5.0*

This section discusses some of the assumptions used in developing the proposed design methods, as well as factors that would affect the accuracy of NLR predictions.

*Appendices*

The first appendix provides a description of design and construction methods necessary to achieve NLRs of 20, 25, 30, and 35 dB. It supplements and details the design requirements presented in Section 4.0. Once the reader is familiar with this Guide, Section 4.0 and Appendix A can be used as stand-alone references in implementing the designs. Appendices B and C will be useful to local officials. Appendices D and E will be useful to builders, as they provide information on many acoustical product manufacturers and certified test laboratories. Appendix F is a glossary that will be useful to all parties. Appendix G provides additional information regarding high wind zones and would be of most interest to builders.

*General Notes*

This Guide seeks to provide clear, unambiguous direction that is practical and can be implemented with minimum additional cost. However, construction quality is especially





important for maintaining the acoustical integrity of a design. For example, even a good window, if not installed properly, will allow a significant amount of noise into the building. High-quality construction standards are absolutely essential for these techniques to work effectively.

The design packages in Section 4.0 and Appendix A address typical home sizes and styles. The noise analysis used here makes assumptions about the number and type of exterior doors, the floor area, and the amount of furnishings in the room. Unusual homes may require more specialized analysis to ensure compliance. For example, very small rooms with a normal area of windows have a larger window-to-floor area ratio and may allow more noise intrusion than typical rooms. Homes with large wrap-around porches may provide shielding from noise that the Guide will not anticipate. For these reasons, homes with unique features or with dimensions that differ significantly from the average may require the services of an acoustical consultant in order to ensure adequate noise reduction.

Individuals differ in their response to noise. In an aircraft noise-affected neighborhood, a number of residents are very annoyed by aircraft overflights, while quite a few others are not. If properly implemented, the recommendations in this Guide will reduce noise inside the home to levels that most people will find acceptable. The aircraft will still be discernible; sound insulation is not sound elimination. People will know that a plane is passing overhead but, with the techniques outlined in this Guide, the noise should not be so loud that it interferes with normal daily indoor activities. Those individuals, however, who are most sensitive to noise, may continue to be annoyed. Nevertheless, the number of people who perceive unacceptable indoor noise levels can be significantly reduced by the use of proper construction techniques.

*House Types*

In the MCAS Cherry Point area new homes could include:

- Single-family homes
- Modular single-family homes
- Manufactured ("HUD Code") single-family homes
- Townhouses
- Apartments (rental or condominium)

The recommendations in this guide apply to all of these types of homes, except to HUD Code homes. There are Federal requirements for the construction and safety of manufactured homes. The National Manufactured Housing Construction and Safety Standards Act of 1974 (Title VI of Pub. L. 93-383, 88 Stat. 700, 42 U.S.C. 5401, et seq.) required the U.S. Department of Housing and Urban Development (HUD) to establish construction and safety standards for manufactured homes. The resulting Manufactured Home Construction and Safety Standards, generally

referred to as the "HUD Code" (24 CFR 3280), regulate the design and construction of all manufactured homes in the U.S. A manufactured home (formerly known as a trailer or mobile home) by definition must have "continued transportability." In contrast, a modular home is assembled from panels and is installed on a site-built permanent foundation. Therefore, modular homes do not have continued transportability and are not covered by the HUD Code (see 24 CFR 3280.7). A manufacturer may elect to construct a structure that is both a manufactured and a modular home (see CFR 3282.12).

Only the HUD Code can be used to limit the construction of manufactured homes, with certain exceptions related to wind loads and foundation design. States and localities cannot preempt Federal requirements with respect to the construction and safety of a manufactured home. A locality can require that all other types of housing be built to attain certain noise level reduction goals, but they cannot for manufactured homes. A locality can only prohibit the use of manufactured homes in certain locations such as in a specified noise zone.

Manufactured homes and some modular homes use thinner gypsum board and particular types of mechanical systems. In addition, where it is necessary to use additional layers of gypsum board on walls or ceilings, there is a question of whether the structure can carry the extra weight. This may make it impossible or cost prohibitive to meet the noise reduction goals for manufactured homes and some modular homes.

Therefore, this Guide does not cover sound insulating manufactured homes. Modular homes should be treated no differently than traditional single-family homes.





# 2.0 Noise Control Basics

## 2.1 Units Used in Acoustics

A number of different metrics (measures) have been developed to express various aspects of acoustics. It is important to understand several of them in order to make the best use of this Guide.

Aircraft noise is generally expressed in terms of its A-weighted sound level, in units called "decibels." Strictly speaking, the decibel unit should be abbreviated only by "dB"; however, for clarity "dBA" and "dB(A)" are often used to highlight the fact that the sound level measurement has been A-weighted (this weighting system is described below).

The noise exposure in areas around airfields is expressed in terms of the Day-Night Average Sound Level, which is abbreviated by "DNL" in text and "$L_{dn}$" in equations. DNL is a measure of the average A-weighted sound level of all aircraft flights occurring in a 24-hour period with nighttime operations being counted more heavily as described below. The unit of DNL is also the decibel.

The sound insulation properties of building construction materials are described by Sound Transmission Loss (TL) or Sound Transmission Class (STC). These measures of sound insulation are also described below.

*A-Weighted Sound Level*

The two most obvious characteristics of sound are level and frequency. Level is essentially a measure of loudness that refers to how much energy or power a sound has when we hear it. Frequency is essentially a measure of pitch. A deep-voiced baritone singer has a lower frequency (or pitch) than a soprano voice, though they may be equally loud. Hertz (abbreviated Hz) is the unit used to indicate frequency and is equal to the number of sound waves (cycles) per second. For reference, middle C on a piano has a frequency of exactly 256 Hz. The normal human ear can detect sound frequencies ranging from about 20 Hz to about 15,000 Hz. People do not hear all sounds over this wide range of frequencies equally well, however. The human ear is most sensitive to sounds in the 1,000 to 6,000 Hz range.

In order to reflect the differences in hearing sensitivity to different frequencies, sounds are usually described in terms of A-weighted sound levels. When a sound is A-weighted, sound levels measured in the 1,000 to 6,000 Hz frequency range are increased by a specified amount to account for the fact that the ear perceives them as louder compared to other frequencies.

Similarly, sound levels measured at frequencies outside this range are reduced because the ear is less sensitive in those regions.

*Day-Night Average Sound Level (DNL) and Noise Contours*

Aircraft noise exposure in a community is usually described in terms of noise contour maps. These indicate bands or zones around airfields where the average noise level can be expected to fall within the ranges specified by the contour lines. Most noise contour maps show contour levels of DNL 65 dB and above in 5 dB increments.

The acoustic metric used at MCAS Cherry Point is the Day-Night Average Sound Level (DNL or $L_{dn}$). As noted above, this is a cumulative measure of the noise exposure during a 24-hour calendar day. A 10 dB penalty is added to noise events occurring between 10:00 p.m. and 7:00 a.m. to reflect their greater intrusiveness and potential for disturbing sleep. The DNL is the result of averaging the A-weighted sound pressure level over 24 hours for aircraft activities taking place on an average busy day. The average busy day is determined by analyzing flight activity over a full year and averaging the number of operations that occur during generally busy periods. This gives an indication of the year-round average noise exposure for the community.

*Sound Transmission Loss (TL)*[1]

This is the physical measure that describes the sound insulation value of a building element such as a window or wall. Values of TL are determined in acoustical laboratories under controlled testing methods prescribed by the American Society for Testing and Materials (ASTM). The TL is expressed in decibels (dB), and the greater the sound insulation, the higher the TL value and the less sound will be transmitted through the building material. TL values are determined for different frequency ranges and give an indication of how a building product or assembly responds differently to sounds at different frequencies.

*Sound Transmission Class (STC)*[2]

Since working with a series of TL measurements for different frequencies can be cumbersome, a single-number descriptor based on the TL values has been developed. This rating method is called the Sound Transmission Class (STC). As with the TL, the greater the STC rating for a construction method or component, the higher the sound insulation. Originally, STC ratings were developed as a single-number descriptor for the TL of interior office or apartment walls for typical office noise and speech spectra. Now, they are used for exterior building components as

[1] Tests to determine TL are described in American Society for Testing and Materials (ASTM) Standard E90.
[2] STC is described in ASTM Standard E413.





well. Most acoustical materials and components are commonly specified in terms of their STC ratings.

## 2.2 Aircraft Noise

*Interference with Activities*

The problem of aircraft noise has been recognized and studied in this country since the 1950s. Opinion surveys indicate that interference with telephone usage, listening to television and radio, and conversations invoke the most complaints. However, after a home has been sound insulated, residents notice improvements in their ability to carry out these normal activities as well as to fall asleep and concentrate.

Fears of permanent hearing damage from flyovers have been shown to be unfounded. A large number of studies on the physical health effects of aircraft noise exposure have led to the general conclusion that residences near airfields are not exposed to high enough sound levels to warrant concern. The principal effect of aircraft noise on airfield neighbors is annoyance caused by interference with daily activities.

*Aircraft Noise Characteristics*

Noise intrusion from aircraft activities is perceived as more disturbing than other kinds of noise because of two primary characteristics. Unlike many other community noise sources, such as highway noise, which tend to be fairly constant, aircraft noise consists of sporadic individual noise events with a distinct rise and fall pattern. People do not, in general, respond to these events as just another component of the "background noise" of their day-to-day lives. Some people get used to the noise, but many others feel that each individual flyover event is recognizable and disturbing.

The noise level experienced at a particular dwelling will depend on its location relative to the aircraft flight paths and the mode of ongoing aircraft operations (arrivals or departures). For homes very near the airfield, the quality that makes aircraft noise more intrusive is its higher level, or loudness, than other types of community noise.

*Aircraft Sound Spectrum*

The noise produced by modern aircraft contains acoustical energy over a wide frequency range. The audible noise includes many sounds from a low-frequency "rumble" to a high-frequency "whine." The exact character depends on the aircraft type and the operation performed (takeoff, landing, or ground run-up). Low-frequency noise (below 250 Hz) penetrates walls, roofs, doors, and windows much more efficiently than does high-frequency noise. Higher frequencies (above

1,000 Hz), however, are carried through cracks and vents better. Also, people hear higher frequency sound better, the human ear being more sensitive above 1,000 Hz than below.

Since aircraft noise differs somewhat from other types of community noise, it is important to identify the characteristics of the noise that sound insulation is protecting against. Most materials and construction methods are more effective at insulating in one part of the frequency spectrum than in others. Knowing the noise characteristics helps in choosing the best materials for sound insulation. This Guide has been designed specifically to protect against noise from the types of aircraft that use MCAS Cherry Point rather than noise from civilian aircraft, highway traffic, or other types of noise sources.

Most of the sound energy from military aircraft operations is found at middle frequencies. This is different from civilian aircraft that have more equal sound at low and middle frequencies. Section 2.4 discusses the process by which sound is transmitted into a dwelling interior.

## 2.3 Sound Insulation to Reduce Noise

Total "soundproofing" of the dwelling, such that aircraft operations are not heard, is usually not practical or cost-effective. The goal for residential sound insulation is to *reduce* the dwelling interior noise level due to aircraft operations to an acceptable level, that is, a level where it no longer interferes with daily activities.

*Interior Noise Objectives*

The U.S. Department of the Navy has established land use compatibility guidance for exposure to aircraft noise. The land-use compatibility table states that residential use is discouraged in the 65-69 dB DNL zone, and strongly discouraged in the 70-74 dB DNL zone. The table recommends that a home exposed to a DNL of 65 to 69 dB should provide at least 25 dB of NLR, a home exposed to a DNL of 70 to 74 dB should provide at least 30 dB of NLR, and a home exposed to a DNL of 75 to 79 dB should provide at least 35 dB of NLR. The use of other NLR goals may be appropriate in many cases, especially if a noise metric other than DNL is used in the community. The table assumes that typical homes can provide an NLR of 20 dB; separate recommendations are provided in this guide for homes exposed to a DNL of 60 to 64 dB in order to ensure that an NLR of 20 dB is provided.

*Room Variations*

The noise level of different rooms in a house depends on the amount of sound absorption within the room, as well as on the noise entering from outside. Upholstered furniture, drapes, and carpeting absorb sound while hard surfaces do not. The exterior sound level is transmitted through the outside walls (depending on their construction) and is further modified by the





absorption inside the room (from the various furnishings) to determine what the interior noise level will be. *The calculations contained in this report are based on the assumption that all rooms would be furnished; noise levels in unfurnished rooms would be higher.*

*Expected Dwelling Noise Level Reduction*

An acoustically well-insulated home with windows and doors kept closed can provide 30 to 35 dB of NLR whereas more typical, unmodified designs might provide 20 to 25 dB of NLR. Experience has proven that the objectives discussed here are reasonable when construction materials and methods follow the guidelines presented in Sections 3.0 and 4.0. Providing more than 40 dB of noise level reduction is not usually practical for a typical residence. Of course, sound insulation will not have any effect on outdoor activities. The advantage of sound insulation is that it provides a refuge from external aircraft noise levels.

In general, it is more efficient and cost effective to take acoustic performance into account at the start when designing and building a home. Remodeling a pre-existing home is far more costly and time consuming than anticipating and building using good sound insulation techniques. This Guide was developed for new homes; different materials and techniques would be appropriate when renovating houses to achieve the NLR goals.

## 2.4 Basic Sound Insulation Concepts

*Sound Transmission*

In order to effectively examine noise control measures for dwellings it is helpful to understand how sound travels from the exterior to the interior of the house. This happens in one of two basic ways: through the solid structural elements and directly through the air. Figure 2-1 illustrates the sound transmission through a wall constructed with brick exterior, wood studs, an interior finish, and sound absorbent material in the stud cavities.

The sound transmission starts with noise at the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which in turn sets the interior finish surface vibrating, with some energy lost in the airspace. This finish surface then radiates sound into the dwelling interior. As the figure shows, some vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.

Openings in the dwelling, which provide air infiltration paths through windows, vents, and leaks, allow sound to travel directly into the interior. This is a very common, and often overlooked, source of noise intrusion. Basically, any way that air enters a home, sound will also enter.

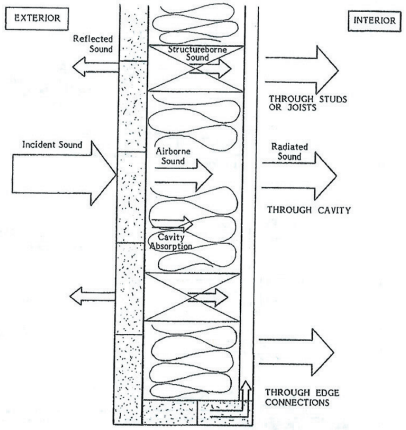



**Figure 2-1. Pictorial Representation of Sound Transmission Through Built Construction**

Flanking is a similar concept and usually refers to sound passing around a wall. Examples of common flanking paths include: air ducts, open ceiling or attic plenums, and crawlspaces.

Figure 2-2 displays the three different major paths for noise transmission into a dwelling: air infiltration through gaps and cracks, secondary elements such as windows and doors, and primary building elements such as walls and the roof.

Low-frequency sound is most efficiently transmitted through solid structural elements such as walls, roofs, doors, and windows. High frequencies travel best through the air gaps.

Within these broad categories, different building materials have different responses based on the frequency of the incident sound and varying abilities to insulate against sound.





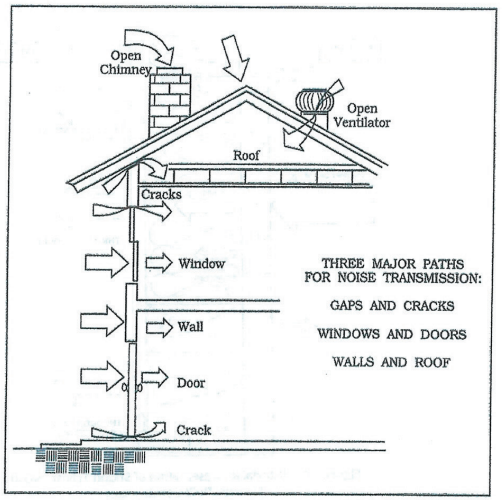



**Figure 2-2. Sound Transmission Paths Into Dwelling Interiors**

*Reducing Transmitted Sound*

The amount of sound energy transmitted through a wall, roof, or floor can be limited in several ways. First, all air infiltration gaps, openings, and possible flanking paths must be eliminated wherever possible. This is the single most important, but occasionally overlooked, step in noise level reduction. This includes keeping windows and doors closed and putting baffles on open-air vents. Some materials reflect more of the incident sound, converting less of it into vibrational energy. The mass of the exterior and interior panels influences how much sound will pass through them. The more mass a structural element has the more energy it takes to set it into vibration, so using heavier building elements generally blocks more noise. Then, absorption in the air cavity, resilient mounting of interior finish panels, and mounting the exterior and interior panels on different studs can further reduce the sound transmitted to the room. The primary approaches for improving sound isolation are:

1. Elimination of openings and flanking paths.
2. Using higher STC windows and doors.
3. Adding mass to walls or ceilings.
4. Isolation of panel elements through increasing their separation, mounting the interior and exterior panels on different studs, or resiliently mounting the interior panels.
5. Adding absorptive materials between the studs or joists.

*Acoustical Design*

The most important, or controlling, sound paths must be identified in order to know how to modify a dwelling design to meet a specified noise criterion. The ideal sound insulation design would focus on those elements that transmit the most acoustical energy into a room. This eliminates any weak links in the building's sound insulation envelope.

Windows generally allow more noise intrusion than walls; as more of the wall area is taken up with windows, the overall noise protection decreases. This effect is significant even for massive wall materials, such as brick. Intuition suggests that a brick wall would protect better against sound than siding and this is true when these materials alone are compared. But, putting a weak window or an especially large window into a brick wall will cause the overall construction to perform very poorly since noise enters through the weakest path. On the other hand, installing a high-STC window in a wood-framed sided wall will give much better noise level reduction than building a weak window into a brick wall.

The STC rating, defined in Section 2.1, is a measure of the material's ability to insulate against sound; the higher the STC rating, the better the insulator. Proper use of STC ratings will be discussed in more detail in Section 3.1. Table 2-1 gives a brief list of typical STC ratings for common building elements. The variability for walls and roofs is due to the type of studs or joists, or the thickness of concrete. The ratings in Table 2-1 cannot be used directly to estimate noise level reduction because they do not account for the presence of other elements or the areas of each element.

In most cases, after making sure that openings remain sealed, the windows are the controlling sound paths. Using acoustical windows typically does more to improve the sound insulation performance than any other design modification. Exterior doors also typically require high STC ratings. Depending on the noise level reduction goal, other elements may become important as well. Ceilings and exterior walls may require special construction, particularly in the higher DNL zones. Treatments for these paths and others are discussed in Sections 3.2 through 3.8 of this Guide.





**Table 2-1. Typical STC Ratings for Common New Construction Elements**

| | STC (dB)[1] |
|---|---|
| **LARGE ELEMENTS** | |
| EXTERIOR WALLS | |
| Vinyl Siding on Wood Frame | 36-37 |
| Insulated Concrete Forms | 42-55 |
| ROOFS | |
| Vented Attic with Flat Ceiling | 49-53 |
| Vaulted Ceiling | 41-45 |
| FLOORS | |
| Elevated House on Pylons | App. 43 |
| Vented Crawlspace | App. 48 |
| **SMALL ELEMENTS** | |
| WINDOWS | |
| Double Pane Glass | 24-29 |
| DOORS | |
| Swinging Steel or Fiberglass | 23-25 |
| Swinging Steel or fiberglass with Storm | 29-33 |
| Sliding Glass | 25-29 |

[1] A higher STC value generally indicates greater sound insulation.

*Problem Areas*

Sound intrusion problems are commonly caused by:

1. Building construction components and configurations not providing sufficient sound insulation.
2. Building elements, such as windows, doors, walls, roofs, and floors chosen and combined in an unbalanced way so that some parts are much weaker sound insulators than others.
3. Unintended openings or sound-flanking paths caused by improper installation of construction elements.

*Thermal Insulation*

While homes that are well insulated thermally often perform well acoustically, thermal insulation is not always a good indicator of sound insulation. Many thermal windows provide little sound insulation when compared to walls or acoustical windows and are frequently the weak link in the building envelope. However, thermal treatments usually eliminate air infiltration and may serve to improve the acoustical performance of a dwelling for that reason. The presence of insulation in walls or ceilings is far more important than the type of the insulation.

*Shielding*

The last concept to consider is shielding. This refers to the fact that the side of the dwelling that faces away from the flight path and does not have an open line-of-sight to it will be protected somewhat from the noise. The shielding may be as much as 10 dB in some cases, though values on the order of 5 dB are more common. Sides of the house facing directly toward the flight path are unshielded. Sides that face the flight track at an angle may benefit from some minor shielding effects. Sometimes, however, sound is reflected off nearby buildings in such a way as to counteract the shielding benefits. Shielding must be examined on a case-by-case basis and the possibility of aircraft straying from the usual flight path must be taken into account before assuming a consistent shielding effect. Considering shielding is not useful when predicting indoor noise levels at homes near MCAS Cherry Point, because the aircraft typically fly all around houses instead of only on one side.





## 3.0 Building Elements

This section provides specific guidelines for modifying standard construction designs and practices to meet the need for aircraft sound insulation in new homes. A general discussion of construction materials and methods is given in Section 3.1. Sections 3.2 through 3.8 address techniques for use with weatherstripping, windows, doors, walls, ceilings and roofs, floors and crawl spaces, and mechanical systems and building penetrations. Section 3.9 provides cost estimates for sound insulation treatments.

In high wind (velocity) zones the building code requires using windows and doors that are rated for impact resistance. Any acoustically rated windows or doors must also be able to meet these criteria.

The recommendations apply to all habitable rooms, as well as to rooms that are open to habitable rooms.

### 3.1 Evaluating Construction Materials and Methods

*Informed Use of STC Ratings*

STC ratings are the most common measures of acoustical performance given by manufacturers of building materials. For this reason, it is important to understand how to use STC ratings to evaluate construction materials and systems.

Two different construction methods or components may have identical STC ratings and yet may block aircraft noise differently because or their response at different frequencies. One method or component may perform better than another at some important frequencies. Selecting a construction method or component from a group only on the basis of the highest STC rating may not provide the intended sound insulation. This is because the STC rating does not take into account the strong low-frequency nature of both civilian and military aircraft noise. This guide has taken into account the ability of typical products currently available to block aircraft noise. The recommended materials listed in Section 4.0 and Appendix A (and their STC ratings) were evaluated for frequency response prior to formulating the design packages.

*Combining Building Elements*

As mentioned earlier, the acoustical performance of the building depends on the combined performances of each of the elements. The final result depends on the transmission loss (or STC) and the relative surface areas of the elements. If any of the components has poor insulation properties the overall performance can be seriously weakened. This is why it is important to focus on the weaker elements and to consider the relative areas of the components.

As a rule-of-thumb, if a weaker element will be included in the assembly, its size should be kept to a minimum. For example, if a pane of glass is to be used for a vision panel in a door, it should be kept small and should be constructed of insulated glass. Similarly, very large windows degrade the noise level reduction of an otherwise effective concrete wall. If a cathedral ceiling is included, it should be designed so that there is a larger-than-standard air space between the ceiling and the roofing system. Sensible compromises can be made to preserve the noise level reduction of the home without sacrificing aesthetics, provided the principles explained in this Guide are employed.

## 3.2 Sealing and Weatherstripping

Good weatherstripping and caulking around windows and doors is crucial to effective sound insulation. The STC rating of the overall assembly can vary by as much as 2 to 4 points, depending on perimeter infiltration. For these assemblies, any perimeter leakage will degrade the performance of the window or door and can be the controlling factor in the noise isolation. This is generally not an issue with new construction, but homeowners must understand the importance of maintaining weatherstripping in good condition.

*For acoustical purposes, compressible neoprene weatherstripping is preferred over felt or other fibrous types.* Neoprene is not as porous and compresses better against the window or doorframe. Also, felt and fibrous weatherstripping materials tend to deteriorate more quickly than neoprene and must be replaced more often.

## 3.3 Windows

### *Options Overview*

The exterior windows are usually one of the weakest elements in the dwelling's sound insulation performance. Improving the acoustical properties of the windows is one of the simplest ways of lowering the overall sound transmission into the house. Design modification options include using thicker glass and wider airspaces between the panes of glass. Specialized acoustical windows provide maximum sound insulation, and should be used in the loudest environments, as specified in Section 4.0 and Appendix A. See Appendix G for additional information on high wind zone requirements.

### *Acoustical Performance*

The thicker, high-quality insulated glass units should be ¾ inch to 1 inch thick and, for the best noise level reduction, should incorporate at least one lite (pane) of laminated glass, preferably ¼ inch thick. Laminated glass provides significantly better transmission loss than standard, float glass. Tempered glass is also acoustically superior to standard glass, but is not nearly as effective as laminated glass. Off-the-shelf thermopane units are typically available with ratings ranging





from STC 24 to 29, and upgraded acoustical units with thicker glass may provide ratings as high as STC 30 to 36.

Acoustical windows differ significantly from ordinary residential windows. The design of an acoustical window has a greater frame depth, the glass lites are heavier, the frame extrusions may be thicker, and the weatherstripping and seals are more substantial. All of these measures are necessary to provide the high degree of sound insulation required for the window assembly.

In order to achieve ratings above approximately STC 36 it is typically necessary to use either a double pane window with a storm unit attached (often referred to as a "combination" window), or an assembly of two single or double pane windows connected together (often referred to as a "dual" window). Figure 3-1 shows a typical acoustical combination window installation with the most important features highlighted. Figure 3-2 shows schematically the features of an acoustical dual window. Combination and dual acoustical windows with STC ratings of 37 to 46 are available in a variety of styles and finishes, including aluminum and vinyl, and special windows with STC ratings in the 50s are available from a few manufacturers. Manufacturers of specialized acoustical windows are listed in Appendix D. They are considerably more expensive than typical residential windows.

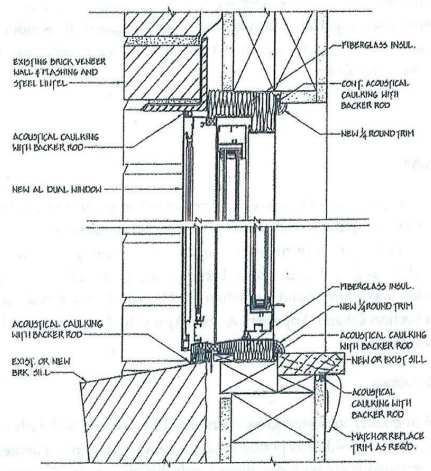



**Figure 3-1. Typical Combination Window Installation Detail**

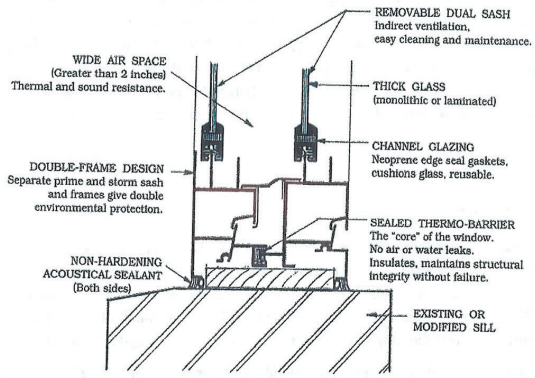



**Figure 3-2. Typical Dual Acoustical Window**

*Thermal Performance*

Insulated glass windows are recognized to block the transmission of heat (in winter or summer) much more effectively than single pane glazing. Increasing the thickness of the glass and the airspace, as recommended for noise level reduction, further improves their thermal performance.

Because of the above-mentioned design features, plus the common inclusion of thermal barriers at the frames, acoustical windows perform exceptionally well as thermal barriers. They allow significantly less air infiltration and have a higher R-value (a measure of thermal resistance) than most off-the-shelf single pane and double pane windows.

*Installation Considerations*

For the windows to provide the required noise reduction they must remain tightly closed. Ways to maintain ventilation will be discussed in Section 3.8. Any type of window, such as double-hung, single-hung, horizontal rolling/sliding, casement, fixed, and awning/hopper, is acceptable for noise reduction, provided it has the required STC rating. However, it must be noted that the STC ratings vary a few points between these various operational types for a given window manufacturer or model. Fixed windows normally have the highest STC rating, sliding/rolling windows have the next highest, hung windows have slightly lower ratings, while casement and awning/hopper windows tend to have the lowest STC ratings.





Other considerations when preparing window specifications include maintainability, warranty, manufacturer's service, and proper installation. It is possible to install the best acoustical window improperly. If it does not fit tightly enough, air infiltration will significantly reduce the effectiveness. Starting with a too-small window unit and filling in the void around the window with a low-mass material such as fiberglass batt insulation is unacceptable. Continuous wood blocking infill is recommended with fiberglass insulation filling small voids.

## 3.4 Doors

*Options Overview*

Doors are comparable to windows in the amount of sound they allow to enter the dwelling. Many typical residential doors require modification or substitution to provide the necessary protection from aircraft noise. As with windows, there are specialized acoustical units available, as well as acoustical storm doors. See Appendix G for additional information on high wind zone requirements. The following factors are important in evaluating doors for sound insulation:

- Door composition: insulated metal or fiberglass, sliding glass; core material, additional internal insulation, etc.
- Door weight (can be estimated by pull-weight).
- Presence and type of fixed window panels.
- Quality of seals and weatherstripping and how tightly they seal.

Some of the options for improving the noise level reduction of residential doors include:

- Selecting a door with a high STC rating.
- Installation of a tightly fitting storm door with thick (or laminated) glass; or use of a specialty acoustical storm door.
- Use of thicker glass in sliding glass doors or specialty acoustical sliding glass doors.

*Standard Doors*

STC requirements are outlined in Section 4.0 and Appendix A for each type of door (swinging and sliding doors).

Glass panels in the primary door can reduce the STC rating by several points, depending on the thickness of the lite and the surface area. The thinner the glass and the larger the area it covers, the more it decreases the sound insulation of the door. When vision panels are required, it is best to keep them small and use insulated glass units with thick glass.

*Swinging Storm Doors*

External storm doors are sometimes used in the MCAS Cherry Point area and can improve the STC rating by approximately 5 to 9 points, and up to 19 points with special acoustical storm doors. In order for storm doors to be effective for sound insulation, they should incorporate thick glass (ideally 1/4-inch-thick laminated glass in high noise zones) and have a heavy core. Storm doors must be mounted year-round to provide an acoustical benefit. Replacing the glass panel with a screen insert in the summer months will reduce the sound insulation of the home considerably but many homeowners may wish to exercise this option for periods when aircraft activity is light. A list of acoustical storm door suppliers is included in Appendix D. It can be assumed that the rating of a prime-and-storm door combination is STC 37 provided the rating of the *storm* door alone is at least STC 30 and the airspace between the prime and storm door is at least 2".

*Acoustical Swinging Doors*

Acoustical doors, with a typical rating of STC 29 to 43, are often similar in appearance to standard entrance doors. However, due to the high cost of acoustical doors, it is often preferable instead to use more typical residential doors with acoustical storm doors.

Because of their specialized construction and superior sealing design they provide a very noticeable improvement in noise reduction. Whether metal or wood, the internal construction of acoustical doors differs substantially from standard doors. Layering of materials, along with added absorption and mass, increases their weight to approximately 12 to 14 pounds per square foot.

To eliminate sound flanking between the closed door and the jamb, acoustic doors are designed with special fixed acoustical seals at the sides and top. A drop seal along the bottom activated by a cam rod when the door is closed is sometimes used to make tight contact with the threshold. In other cases, fixed bottom seals that contact a raised threshold or saddle are used. Also, because of their extra weight, acoustical doors usually require reinforcement of the door frame and heavy-duty mounting hardware and hinges. Manufacturers often provide customized frames with their acoustical doors.

*Sliding Glass Doors*

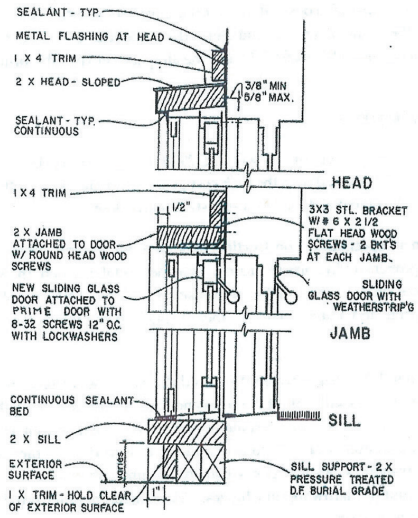
There are two options for improving the sound-insulating properties of sliding glass doors: using acoustical units, or using primary and secondary doors. The disadvantages of acoustical sliding glass doors are that they are very expensive, very heavy, and can have a high threshold. The disadvantages of using primary and secondary sliding glass doors is having to open two doors to leave the building, and that the two frames would not fit in the width of a typical 2x4 stud wall. This same secondary door concept can be used with hinged patio doors. Of course, the installer





must ensure that there is no conflict in the operation and opening hardware of the two door sets. Good weatherstripping should be installed on both doors.

Installing a secondary sliding glass door generally requires building a second frame positioned to mount the door approximately 3 to 4 inches away from the primary door. This dual-door assembly has proven successful in that it raises the STC rating by 14 to 16 points (when the secondary door has an STC 29 rating and utilizes 1/4" laminated glass, and there is at least 3.5" airspace between the primary and secondary door). Figure 3-3 shows a system of two sliding glass doors with the secondary door mounted outside of the typical door position.




NOTES: 1. NEW SLIDING GLASS DOOR TO HAVE DUAL OPERABLE PANELS TO FACILITATE CLEANING OF DOORS.

**Figure 3-3. Secondary Sliding Glass Door Detail**

*Door Sidelights and Window and Door Transoms*

Door sidelights and window and door transoms should not be neglected. However, there rarely are acoustical test results available for the window or door assembly that include the applicable

transoms or sidelights. Therefore, when identifying STC ratings in Section 4.0 and Appendix A, we recommend treating transoms and sidelights as separate windows, even if they are attached to a window or door.

*Installation Considerations*

As with windows, it is of critical importance to ensure that the door fits well, that all gaps and leaks are sealed, and that the door remains closed. High-quality acoustical weatherstripping is recommended to ensure the acoustical performance of the door. Sound attenuation through standard doors can be improved by fitting them with special acoustical seals, including drop seals mounted to the back or fully mortised in the door's bottom rail, and compressible bulb-type neoprene gaskets at the jambs (sides) and head (top). If the door does not fit squarely into the frame it will not seal properly and unnecessary noise infiltration will result. In all cases, avoid openings such as mail slots in doors or the use of pet doors.

## 3.5 Walls

*Determining Wall Designs*

Depending on the dwelling's exterior construction and materials, it may be necessary to use specialized designs for walls. Generally, walls that have vinyl or cement board siding require improvements such as staggered studs or resilient channels in the highest noise impact zones. Dwellings that use insulating concrete forms or other masonry systems typically do not.

For the purposes of this design guide, walls in the MCAS Cherry Point area can be classified as one of the two following types:

- Insulated Concrete Form (ICF) Construction: At least four-inch thick normal weight concrete between approximately 1-3/4" to 2" insulating forms, with 1/2" gypsumboard at the interior. The entire wall must have concrete, not just a portion of it, for this designation to apply. If siding or a skim coat of stucco is applied over insulated concrete forms, the wall is still designated an insulated concrete form wall.
- Siding on Wood-Frame Construction: All types of siding including vinyl and cement board. Construction includes siding on 1/2" nominal OSB or plywood sheathing on 2x4 or 2x6 wood studs spaced 16" on center with batt insulation, and 1/2" gypsumboard at the interior. If a portion of the wall is ICF and a portion wood-framed, consider the wall to be sided on wood-frame construction.

The rare instances of Exterior Insulating Finish Systems (EIFS) on wood framing should be designated "Siding on Wood-Frame Construction" for the purposes of this Guide. The rare instances of Stucco on concrete masonry should be designated "Insulated Concrete Form





Construction" for the purposes of this Guide. The rare instances of 4" brick veneer or 8" concrete block should be designated ICF.

When studs are spaced 24" on center the acoustical performance may be slightly better than for other sided wood-framed walls. Conversely, when the stud spacing is 8" or 12" on center the acoustical performance may be worse; using this stud spacing is common for the first floor of a three-floor home, in high-wind (velocity) zones, or when windows or doors comprise a large proportion of the wall.

It is sometimes necessary for structural reasons to use a layer of plywood or OSB at the interior surface of the wood studs behind the gypsum board. This should not adversely affect the STC rating.

*Specific Interior Wall Designs for Siding on Wood-Frame Construction*

One technique for increasing the mass and resiliency of the wall or ceiling is to attach the gypsumboard to the studs with 1/2-inch, resilient, vibration-isolation channels ("resilient channels", or "RC"). This will provide an STC rating improvement of 7 points over that for a typical wood frame wall construction. The resilient channels should be attached to the studs so that they run horizontally for walls (and perpendicular to the joists for ceilings). This minimizes the vibration transmission from the supporting studs (or joists) to the channels and the gypsumboard. The spacing of the channels should be no closer together than specified by the channel manufacturer; typically this is 24" on center. The screws used to attach the gypsum board to the channels must be short enough that they do not contact the studs (or joists). The common installation error of using too long screws allows vibration to travel from the stud to the gypsumboard, rendering the system ineffective. An alternative to this design is to use a new product called resilient sound isolation clips with rigid steel channels. This product is available from PAC International. It is more costly than resilient channels and uses more wall thickness but provides significantly better acoustical performance.

A second technique involves using the resilient channels mentioned above, and changing the wall construction from 2 x 4 studs to 2 x 6 studs. This will increase the STC by 11 points over typical siding on 2x4 stud construction, and will allow space for R-19 insulation.

The third, and most effective, option is to construct the interior wall on a set of staggered studs so that the interior and exterior finish surfaces are not rigidly connected to each other except through the top and bottom plates. This system uses two rows of studs: one row of studs spaced 16" on center supporting the sheathing, and a second row spaced 16" on center supporting the interior wall finish. The end result is that there are studs each 8" on center. Figure 3-4 shows how to implement this construction. This modification provides acoustical decoupling and separation between the exterior and the interior of the room, resulting in a 13-point increase in the STC rating over standard siding on 2x4 studs. A larger space between the interior and

exterior panels will yield a greater STC improvement. In a staggered stud wall, at windows and doors it is necessary to use 2x6 framing; therefore, the acoustical benefit of staggered studs is dramatically reduced when there are many windows or doors. If it is necessary to have 2x6 studs for strength, a variation on this design is to use 2x6 studs staggered on a 2x8 base. Such a design should provide a generally similar acoustical performance as the 2x4 studs staggered on a 2x6 base. With any staggered stud design it might be necessary to provide additional fire stopping.

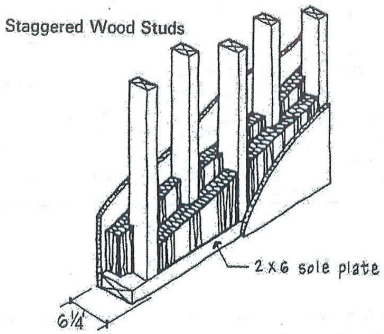



**Figure 3-4. Staggered Wood Stud Construction**

To absorb sound, fiberglass batts or blankets are placed between the studs in the wall cavity. Batts or blankets should be held firmly in place between studs, with fasteners if necessary, to prevent sagging; however, packing the insulation such that it is compressed may slightly *reduce* its acoustical (and thermal) performance. Blown-in insulation is not recommended in walls for acoustical purposes because of the tendency to compact over time.

*Specific Interior Wall Designs for Insulating Concrete Form (ICF) Construction*

The primary way to improve the STC rating of an ICF wall is to select a wider wall that allows a wider pour of concrete. The typical wall was assumed to have a 4" thick pour of concrete. The next thicker wall considered was with a 6" thick pour of concrete. The STC ratings of this assembly will vary based on the thickness of the forms and the type of exterior finish.

The wall construction designs referenced above are summarized in Table 3-1. In this table O.C. is the on-center spacing of the studs. The STC rating for walls with 4" brick veneer will be slightly higher than for ICF walls due to the presence of the wood studs.





**Table 3-1. Acoustical Wall Designs and STC Ratings**

| | Exterior Side | Structure | Interior Side | STC Rating |
|---|---|---|---|---|
| *Resilient Channel on 2x4 studs* | Siding, Wood sheathing | 2x4 16" O.C. with batt insulation | RC on studs, 1 layer ½" gypsumboard | 43 |
| *Resilient Channel on 2x6 studs* | Siding, Wood sheathing | 2x6 16" O.C. with batt insulation | RC on studs, 1 layer ½" gypsumboard | 47 |
| *Staggered 2x4 on 2x6 base* | Siding, Wood sheathing | 2x4 16" O.C. for each row (staggered on 2x6 base plate) with batt insulation | 1 layer ½" gypsumboard (attached only to interior-side studs) | 49 |
| *Staggered 2x6 on 2x8 base* | Siding, Wood sheathing | 2x6 16" O.C. for each row (staggered on 2x8 base plate) with batt insulation | 1 layer ½" gypsumboard (attached only to interior-side studs) | Approx. 50 |
| *ICF with 4" Concrete* | 1-3/4" Form | 4" normal weight concrete | 1/2" Gypsumboard on 1-3/4" Form | High 40s |
| *ICF with 6" Concrete* | 1-3/4" Form | 6" normal weight concrete | 1/2" Gypsumboard on 1-3/4" Form | Low 50s |

## 3.6 Ceilings and Roofs

Improved ceilings are sometimes necessary where there is a roof over noise-sensitive rooms such as bedrooms, kitchens, living rooms, family rooms, etc. There is no need to modify the ceiling of any first-floor rooms where they are completely covered by a second story room. Non-habitable rooms, such as garages and mudrooms in breezeways, are generally not given improved ceilings unless they open directly to habitable rooms without interior doors in between the rooms.

*Specific Interior Ceiling Modifications*

The ceilings of top-floor rooms may need to be modified to provide increased noise protection. The same methods that are used in wall constructions can be used for ceilings. The standard roof construction in the MCAS Cherry Point area is assumed to be: asphalt shingles or standing seam metal roofing, plywood or OSB roof deck, ridge and soffit vents, engineered wood trusses at least 14" deep throughout the span, 10" minimum thickness of blown-in or batt insulation, and 1/2" gypsumboard at the interior. This design is designated "vented attic" construction and has an STC 45 rating. Resilient channels mounted perpendicular to the bottom of the ceiling joists with the gypsumboard attached to the channels will increase the rating to approximtately STC 55.

With some vaulted ceilings the roof framing is less than 14" deep and the STC rating is significantly lower. One such design is shingles, wood roof deck, 2x10 rafters with batt insulation, and 1/2" gypsumboard. This design has a rating of only STC 33. To provide good acoustical performance the roof framing should be at least 14" deep (throughout the span), when sound insulation is being considered.

Attic access panels, pull-down stairs, and whole-house ceiling fans should have movable or operable covers consisting of 3/4" plywood, or other equally massive material, with continuous neoprene perimeter seals.

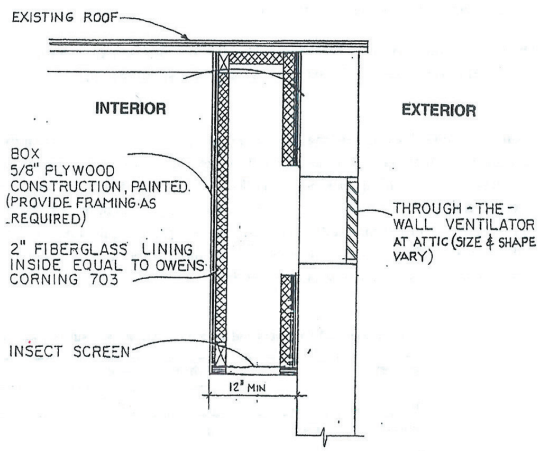



**Figure 3-5. Built-in Place Gable Baffle**

*Attic Vents*

Attics typically have open-air vents at the gable ends or a combination of ridge and soffit vents. Soffit vents are shielded by the roof and generally need no modification. Off-the-shelf acoustical louvers can be applied to baffle the sound passing through gable-end vents. Built-in-place baffles could be used beside gable end vents or under ridge vents to reduce noise intrusion (see Figure 3-5). These consist of 3/4" plywood covered with 2" thick rigid fiberglass insulation; the plywood panels are oriented in such a way that noise (and air) must be reflected on at least one fiberglass-





lined surface before it can move into the attic. However, these baffles must be designed so as not to reduce attic ventilation.

*Attic Insulation*

When considering the upgrade of thermal insulation to reduce noise levels it is important to understand what the insulation will do. Thermal insulation materials will act to absorb sound that is reverberating in the attic or in the space between flat panels. It does not prevent noise from entering the space. That is, it has no appreciable acoustic "insulating" properties but acts as an absorbent instead. To keep sound out, barriers must be used which increase the mass of the roof or ceiling. As a sound absorbent, fiberglass, or mineral fiber batts and blown-in fiberglass or cellulose can be applied between the rafters or ceiling joists.

The sound absorption of a material should not be confused with noise level reduction (NLR). There is no direct relationship between a material's sound absorptive properties and the overall NLR.

A simple method for determining the proper thickness of sound-absorbent materials is to use the concept of the material's thermal rating (R-value). This R-rating is a commonly used and well-known rating for building products. The R-values and thickness for several common insulation materials are given in Table 3-2. The value of the sound absorption at lower frequencies depends on the thickness of the material. For noise sources with a significant low-frequency component, such as aircraft flyovers, the thickness is the most important parameter. Thicker materials provide better low-frequency sound absorption.

**Table 3-2. Material Thickness and R-Value for Common Insulating Materials**

| Material | Thickness, Inches | | |
|---|---|---|---|
| | R-11 | R-19 | R-30 |
| Roll or Batt Fiberglass | 3.5 | 5.25 | 9 |
| Blown-In Fiberglass | 5 | 8 | 13 |
| Mineral Fiber | 4 | 6.5 | 11 |

*Skylights*

Skylights are rare in the MCAS Cherry Point area for new homes. There are possible measures to improve the sound insulation of skylights such as using products with high STC ratings or using secondary interior glass panels with acoustical seals. For the purposes of this guide it is assumed that skylights will not be provided.

## 3.7 Floors and Crawl Spaces

*Options Overview*

Dwellings in the MCAS Cherry Point will usually have one of these three types of floor systems at the lowest level:

- Concrete slab
- Crawlspace
- Pylon foundations (e.g., for a beach house)

Since noise control measures are concerned with the external building envelope, floors between stories in a home are not addressed.

There are three stages of floor design improvements for sound insulation:

- Eliminating, sealing or baffling any openings.
- Installing insulation between the floor joists.
- Attaching a barrier panel to the underside of the floor joists or between the perimeter of the house and the ground (a skirt).

Concrete slabs require no treatment. Crawl spaces and pylon foundations will be discussed below.

*Crawl Spaces*

One common floor system for new residences consists of wood joist construction over a vented crawl space. Typically, the crawl space has 8″ nominal concrete block walls. The simplest way to improve the acoustical performance of a house that has a crawl space with masonry walls is to install off-the-shelf noise control louvers to the under-floor vents (see Appendix D for a list of manufacturers); this is similar to the idea discussed above for roof vents. These louvers provide a noticeable quieting in the rest of the house. If crawl spaces do not have masonry walls, a massive barrier panel can be used as a skirt connecting the bottom of the walls to the ground. 2″ thick precast concrete panels would be ideal. Alternatively, 2x4 pressure-treated wood studs with ¾″ pressure-treated plywood on each side could be used, as long as the joints between the plywood are covered with batten strips. Where double-swing doors are required in flood plains use a similar construction to improve sound insulation.

*Pylon Foundations*

Many beach houses are elevated one story using large (e.g., 8x8 wood) posts called pylons. This design allows some aircraft noise to enter the house through the floor. The typical floor construction in the MCAS Cherry Point area is 3/4″ plywood on joists (open web wood trusses,





plywood joists, or 2x10 joists), with R-19 batt insulation, and 3/8″ plywood covering the bottom of the joists. This assembly has a poor STC rating. However, it will receive a significant amount of shielding from the aircraft flight path by the house. Although it is difficult to quantify this shielding effect, it is likely on the order of 10 STC points. The resulting effective rating is STC 43 if 2x10 joists are used, and higher if deeper structural members are used.

## 3.8 Mechanical Systems and Building Penetrations

In order to maintain the noise reduction benefits of improving windows and doors and sealing leakage paths, it is important to keep these openings closed. While an acoustically well insulated home can provide 30 to 35 dB of noise reduction, this figure drops to 15 dB whenever the windows and doors are open. Heating, ventilation, and air-conditioning (HVAC) systems do not directly affect the sound insulation performance (except when they have vents to the outdoors), but they enable residents to keep the windows and doors shut year-round and benefit from the sound insulation modifications. The following information is not referenced in Section 4.0 but the ventilation features discussed here are strongly recommended and are included in Appendix A.

*HVAC Systems*

In the MCAS Cherry Point area the furnaces are typically located in attics. This location unfortunately allows some noise to enter the home through penetrations of the ceiling. This furnace location is acceptable provided ducts in the attic receive special treatments (see Appendix A). Flexible ductwork should not be used in attics and crawl spaces; heavier sheet metal ducts will provide better sound insulation.

Do not use in-window, through-wall, or through-floor air-conditioners, ventilators, or heaters, i.e., units for which air ducts pass through the building envelope (windows, walls, or floors). On the other hand it is acceptable if only natural gas or refrigerant pipes pass through the building envelope, since these will not allow noise to enter the building. The preferred air-conditioning system is a split system utilizing an outdoor condensing unit.

Ducts to the outside, whether air intake or air exhaust, and all air ducts in the attic or crawl space can be lined with 1-inch acoustical internal lining material, or have at least two 90-degree (right angle) elbows (turns) thereby breaking the line-of-sight to the outside as shown in Figure 3-6. It must be noted that there is concern than this fibrous acoustical lining material will affect air quality. Installing a duct sound attenuator (silencer) is an alternative to this technique; there are silencers available that do not contain fibrous lining. To prevent moisture and grease buildup exhaust fans (bathroom, dryer, kitchen, and range) must <u>not</u> have internal sound lining or silencers that use fibrous lining; the use of the 90-degree elbows and/or fiber-free silencers are

appropriate in these cases. These measures ensure that the ventilation system is not bringing additional aircraft noise into the house.

*Combustion Air Intake*

Fuel-burning appliances such as gas furnaces, gas hot water heaters, and gas dryers can introduce carbon monoxide into the house. To minimize this concern, especially in sound-insulated houses, it is useful to introduce air from the outdoors to the area near the appliance. This is often required in building codes as well. This can be accomplished with small fans called combustion air enforcers.

*Combustion Air Exhausts*

The exhaust ducts for fuel-burning appliances such as water heaters, furnaces, and gas dryers can also be paths for aircraft noise to enter the home. These ducts should be located in closets and never in habitable spaces. These ducts should also have at least two 90-degree elbows as discussed above for HVAC ducts.

*Dryers*

Dryer exhaust ducts can also be paths for aircraft noise to enter the home. Dryers must not be located in habitable spaces. If electric dryers are located near bedrooms or other habitable rooms they may be located in enclosed closets with solid (non-louvered) doors. Always use rigid metal dryer ducts instead of flexible ducts to minimize aircraft noise entering the house.

*Fresh Air*

It is assumed that all new homes in the MCAS Cherry Point area will have central air-conditioning. Whether the air needs to be heated, cooled, dehumidified, or simply circulated and replenished depends on the season. Refreshing the air supply and moving it around is important for health and comfort no matter what the outside temperature. A fresh-air intake could be installed on an air-handling system to provide the required percentage of fresh makeup air combined with the recirculating air. However, when the system is not operating during mild weather no fresh air would be provided. Therefore, fresh-air systems should have a fresh-air intake and allow for ventilation alone when the residents do not want heating or cooling.

In order to ensure that fresh air is provided year-round, the preferred solution is to use active ventilators. The building code does not require these systems unless the house is considered "unusually tight" and meets three conditions. However, for acoustical purposes the use of active ventilation is recommended, especially in high noise zones. To heat the air in winter these systems typically incorporate an electrically operated heating coil or heat recovery feature.

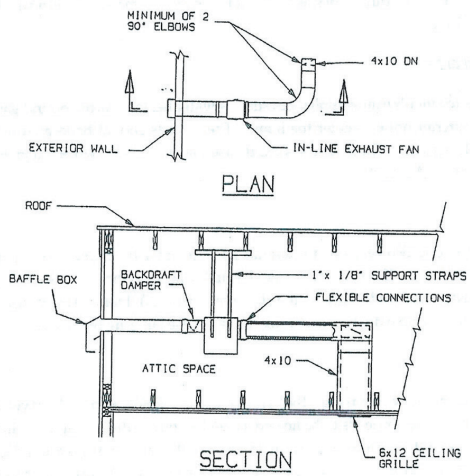




Whatever ventilation system is used, penetrations of the building envelope must be minimized and located as far as possible from habitable areas of the house.

*HVAC Noise and Vibration Control*

It is important to limit the amount of noise the HVAC system generates and the noise it carries in from the outside. Provide vibration isolation mounting for all equipment and locate it so that the structure-borne sound and vibration are kept to a minimum.




ALL DUCTWORK BETWEEN THE CEILING GRILLE AND THE EXHAUST FAN SHALL BE ACOUSTICALLY LINED.

**Figure 3-6. Controlling Noise Entering Through Ducts in Attic Space**

*Kitchen and Bath Fans*

Most kitchen and bathroom designs for new homes already incorporate fans for ventilation purposes. A ducting scheme that incorporates at least one and preferably two right-angle turns is effective at reducing noise infiltration and there should be no direct line-of-sight through the duct from the outside to the inside. In other words, if the duct interior and exterior grilles or covers were removed, it should not be possible to see daylight through the duct. All ducts in the attic

should be rigid metal and not flexible; noise may pass through these elements to other rooms of the house. Refer to the manufacturer for allowable duct lengths, numbers of elbows, and sizes of ducts. Kitchen ranges should have re-circulating fans utilizing a charcoal filter instead of a vented range fan.

*Fireplaces and Wood Stoves*

Some homes in the MCAS Cherry Point area will have prefabricated fuel-burning fireplaces; wood stoves are rare. Ventless units are strongly recommended. For the purposes of this Guide, it is assumed that no vented fireplaces or wood stoves will be allowed in the highest noise zones. In the lower noise zones use acoustical chimney top dampers and tight-fitting 1/4" tempered glass fireplace doors.

*Whole-house Fans*

Some homes in the MCAS Cherry Point area will have whole-house fans. These fans are located in the ceiling of the top floor of the house, usually over a hallway. They allow a significant amount of sound to enter the house. Their use is discouraged in high noise zones.

## 3.9 Costs

The cost to sound insulate a new house can vary greatly from one house to the next. Sound insulation costs are affected by home size, home design, exterior noise exposure zone, and which products are locally available or preferred. Table 3-3 provides the additional costs for using the products and methods recommended in this guide.

The window cost estimates in Table 3-3 are for some typical STC ratings and typical sizes. The costs for lower STC ratings would vary significantly. Many off-the-shelf products can meet the STC 26, 28, 30, and even 32 ratings specified in this guide. Therefore, the additional costs could be zero in some cases.

The cost estimate in Table 3-3 for storm doors assumes that the house would not have used storm doors otherwise; the tabulated cost is the total cost for the storm door, not just an incremental cost for a better product.





**Table 3-3. Additional Costs for Sound Insulation**

| Item | Unit | Average Additional Unit Cost |
|---|---|---|
| 30"x48" STC 36 window | Each | $ 66.00 |
| 36"x72" STC 36 window | Each | $ 91.00 |
| 30"x48" STC 40 window | Each | $ 147.00 |
| 36"x72" STC 40 window | Each | $ 203.00 |
| 30"x48" STC 44 window | Each | $ 195.00 |
| 36"x72" STC 44 window | Each | $ 270.00 |
| STC 29 swinging acoustical storm door | Each | $ 300.00 |
| STC 34 swinging acoustical prime door | Each | $ 486.00 |
| STC 40 swinging acoustical prime door | Each | $ 873.00 |
| 6'-0"x6'-8" STC 34 sliding glass door | Each | $ 437.00 |
| 6'-0"x6'-8" STC 37 sliding glass door | Each | $ 1,312.00 |
| 6'-0"x6'-8" secondary sliding glass door | Each | $ 500.00 |
| Adding second layer of gypsum board to walls | Square-foot | $ 0.70 |
| Adding resilient channels to walls | Square-foot | $ 1.10 |
| Adding second layer of gypsum board to sloped ceilings | Square-foot | $ 1.41 |
| Adding resilient channels to sloped ceilings | Square-foot | $ 2.31 |
| Additional cost for using staggered 2x4 wood studs | Square-foot | $ 1.68 |
| Cover over attic pull-down stairs | Each | $ 400.00 |

## 4.0 Material Selection Chart

The following selection chart is to be used to determine the acoustical design needs of the walls, windows, doors, roof, and floor of each habitable room of a dwelling. Additional requirements are provided in Appendix A; this material selection chart is supplemental to Appendix A. These recommendations also apply to non-habitable rooms that do not have a door separating them from habitable rooms. For each room, design recommendations are determined by following the chart from left to right. First, the required noise level reduction (NLR) must be determined for the dwelling based on its location in a certain noise contour zone. Second, the type of exterior walls must be selected. If the wall has Insulated Concrete Forms (ICF), concrete block, or brick veneer use the "ICF" designation, even if the wall also has wood framing at the interior. Use the "Wood Frame" designation if one of the exterior walls or a portion of one of the walls is wood framed. Third, the number of exterior walls must be selected. Count partial walls as full walls. Count two-story walls as two walls. For example, a room with two two-story exterior walls is considered to have four exterior walls. Fourth, calculate the ratio of the area of windows and doors to the total exterior façade area (including the gross wall/window/door area) of the room. The last five columns contain the recommended modifications for the walls, windows, doors, roof, and floor that must be used to achieve the desired noise level reduction.

The wall modifications apply only to exterior walls. Recommended modifications for wood frame walls are either to use single-leaf resilient channels to hang the gypsumboard ("RC"), to use staggered 2x4 studs on 2x6 plates ("stag"), or to use staggered studs with two layers of 1/2" minimum gypsumboard ("stag 2 gyp"). If the studs must be 2x6 for structural reasons, and the table calls for staggered studs, use 2x6 studs staggered on 2x8 plates.

The door and window modifications only apply to doors and windows that open to the exterior or to partially enclosed spaces such as screened-in porches or garages. The table lists the minimum allowable STC rating.

The roof modifications apply to the roof/ceiling assembly of rooms on the top floor of the house (a room below an attic is considered to be on the top floor). The modifications are either to use two layers of 1/2" minimum gypsumboard ("2 gyp"), or to hang the gypsumboard using single-leaf resilient channels ("RC").

The floor modifications only apply to houses elevated on pylons (e.g., beach houses). The recommended modification for some houses is to use floor framing members that are at least 14" deep with at least 10" thick insulation with 1/2" minimum plywood or OSB at the bottom chords of the trusses ("deep" in Table 4-1).





**Table 4-1. Material Selection Chart and Corresponding STC Ratings**

| NLR | Wall Type | Exterior Walls | Window + Door Ratio | Recommended Modification | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Wall | Window | Door | Roof | Floor |
| 20 | Wd Frame | | | None | STC 28 | None | None | None |
| | Brick or ICF | 1 | | None | None | None | None | |
| | | 2+ | < 75% | None | None | None | None | |
| | | | >= 75% | None | STC 28 | None | None | |
| 25 | Wood Frame | 1 | < 25% | None | STC 26 | None | None | None |
| | | | 25-40% | None | STC 28 | None | None | None |
| | | | > 40% | None | STC 30 | STC 29 | None | None |
| | | 2+ | < 20% | None | STC 28 | None | None | None |
| | | | 20-35% | None | STC 30 | STC 29 | None | None |
| | | | > 35% | None | STC 32 | STC 29 | None | None |
| | Brick or ICF | 1 | < 40% | None | STC 26 | None | None | |
| | | | >= 40% | None | STC 30 | STC 29 | None | |
| | | 2+ | < 20% | None | STC 26 | None | None | |
| | | | 20-30% | None | STC 28 | None | None | |
| | | | 30-75% | None | STC 30 | STC 29 | None | |
| | | | > 75% | None | STC 32 | STC 29 | None | |
| 30 | Wood Frame | 1 | < 20% | None | STC 32 | STC 31 | 2 gyp | Deep |
| | | | 20-30% | None | STC 34 | STC 34 | 2 gyp | Deep |
| | | | 30-50% | RC | STC 32 | STC 31 | 2 gyp | Deep |
| | | | > 50% | RC | STC 34 | STC 34 | 2 gyp | Deep |
| | | 2 | < 20% | RC | STC 34 | STC 31 | 2 gyp | Deep |
| | | | >= 20% | RC | STC 34 | STC 34 | 2 gyp | Deep |
| | | 3+ | < 20% | RC | STC 34 | STC 31 | 2 gyp | Deep |
| | | | 20-70% | RC | STC 34 | STC 34 | 2 gyp | Deep |
| | | | > 70% | RC | STC 36 | STC 34 | 2 gyp | Deep |
| | Brick or ICF | 1 | < 20% | None | STC 30 | STC 29 | 2 gyp | |
| | | | 20-50% | None | STC 32 | STC 31 | 2 gyp | |
| | | | > 50% | None | STC 34 | STC 34 | 2 gyp | |
| | | 2 | < 20% | None | STC 34 | STC 31 | 2 gyp | |
| | | | >= 20% | None | STC 34 | STC 34 | 2 gyp | |
| | | 3+ | < 20% | None | STC 34 | STC 31 | 2 gyp | |
| | | | 20-70% | None | STC 34 | STC 34 | 2 gyp | |
| | | | > 70% | None | STC 36 | STC 34 | 2 gyp | |
| 35 | Wood Frame | 1 | < 25% | RC | STC 36 | STC 34 | RC | Deep |
| | | | >= 25% | Stag | STC 40 | STC 40 | RC | Deep |
| | | 2+ | < 15% | RC | STC 38 | STC 37 | RC | Deep |
| | | | 15-20% | Stag | STC 38 | STC 37 | RC | Deep |
| | | | 20-30% | Stag | STC 42 | STC 37 | RC | Deep |
| | | | > 30% | Stag, 2 gyp | STC 42 | STC 40 | RC | Deep |
| | Brick or ICF | 1 | < 15% | None | STC 34 | STC 34 | RC | |
| | | | 15-25% | None | STC 36 | STC 34 | RC | |
| | | | 25-50% | None | STC 38 | STC 37 | RC | |
| | | | > 50% | None | STC 40 | STC 40 | RC | |
| | | 2+ | < 15% | None | STC 40 | STC 37 | RC | |
| | | | 15-20% | None | STC 40 | STC 40 | RC | |
| | | | 20-30% | None | STC 44 | STC 40 | RC | |
| | | | > 30% | None | STC 44 | STC 43 | RC | |

## 5.0 Limitations

There are many variables affecting the acoustical performance of a room. The recommendations contained in this Guide are based on assumptions of typical parameters. If the actual building design and construction used don't match these assumptions the noise level reduction will be different. Due to the interrelationship between each of these variables there are no upper limits on individual parameters.

In developing recommendations, typical types of rooms were considered. Conditions that would tend to reduce the acoustical performance include:

1. Using a greater area of windows or doors.
2. Having a greater area of exterior walls.
3. Using *smaller* rooms.
4. Adding wall penetrations such as through-wall air-conditioners, heaters, or fans.
5. Using hard room finishes such as ceramic tile or wood floors, and using few furnishings.

The modifications recommended in this Guide are packages designed to work together. That is, improvements to the windows, doors, and mechanical systems complement improvements to the walls and roof. There are always alternative packages of modifications that would be acceptable from an acoustical standpoint. The goal of this Guide was to present one package of modifications for each situation that is reasonable and cost-effective.

The determination of which rooms these recommendations apply to is not always simple. Generally, they apply to habitable spaces (kitchens, living rooms, family rooms, bedrooms, offices, dens, sun rooms, etc.) and do not apply to closets, typical bathrooms, most hallways, garages, utility rooms, and screened-in porches. Some large bathrooms, open foyers, or all spaces that are relatively open to a habitable space should be sound insulated.

The recommendations contained in this Guide are based on calculations using a large number of assumptions and averages of acoustical data for many products. Due to the large variability in acoustical performance of different buildings, and the imprecision of acoustical calculations the performance of a given building may vary from that predicted using this report. There is also no margin for error embedded into these recommendations, except to the extent that houses are grouped in ranges of 5-dB outdoor noise exposure. If a margin of error were desired it would be appropriate to use the recommendations for the next higher noise zone or consult a qualified acoustical consultant. To ensure that the recommended measures comply with building codes consult with an architect.





## APPENDIX A

## NOISE LEVEL REDUCTION DESIGN REQUIREMENTS

# Appendix A
## New Construction: Noise Level Reduction Design Requirements

### SECTION 1: PURPOSE

Exterior noise may be isolated and reduced in homes through construction techniques that selectively increase the sound insulating quality of the exterior of occupied structures. The noise level reduction values specified are 20, 25, 30, and 35 dB.

### SECTION 2: GENERAL REQUIREMENTS

A. The Noise Level Reduction (NLR) requirements specified herein may be achieved by any suitable combination of building designs, choices of building materials, and execution of construction details in accordance with established architectural and acoustical principles. The NLR requirements should be applied to all occupied rooms having one or more exterior walls or exterior ceiling. A room without any exterior walls, and which has an occupied space above its entire area, will not be subject to these requirements.

B. Compliance with the construction standards herein is sufficient to comply with the NLR requirements specified in the various noise zones. These standards are applicable to plans and specifications for any proposed residence. A variety of assumptions were necessary to develop these standards. If the plans and specifications do not indicate compliance with the construction standards herein, the applicant shall provide a written statement from a qualified acoustical consultant certifying that the construction of the building as indicated in the plans and specifications will result in a NLR for appropriate occupied rooms at least as great as the specified NLR requirement.

C. An "exterior" door or window opens to the exterior or to a partially enclosed space such as a screened-in porch. In this standard whenever the words "doors" or "windows" are used it shall be assumed that the standard provision applies only to exterior doors and exterior windows, unless the word "interior" is specifically used for that provision.

D. Sound Transmission Class (STC) ratings for windows and doors are valid only if they are determined by laboratory (not field) tests performed by an independent laboratory for the product. A rating estimated for glass alone is not an acceptable substitute for STC tests of windows or doors, except for determining the rating of sidelights and transoms. Likewise, ratings estimated for door leafs alone are not an acceptable substitute for STC ratings of doors. The installed products must have the same composition and overall configuration such as storm panels, glass type (laminated, tempered, or float glass), glass thickness, spacing between panes of insulated glass, door core, gaskets, weatherstripping, door bottom seals, thresholds, etc., and the same overall configuration as the tested assembly. The overall configuration includes the operational type (casement, double hung, fixed, slider, etc.) in the case of windows, and the general size of glazing (1/8-, 1/4-, 1/2-, or full-view) in the case of doors. Issues that do not affect the acoustical performance such as glass obscuration, internal window muntins, door and window hardware, screens, and applied door moldings can be neglected.





E. Door sidelights and door and window transoms shall be considered "windows" and shall meet the provisions for windows. For these products it is acceptable to reference the laboratory STC rating of the glass alone. However, for the adjacent windows and doors it is still necessary to reference STC tests for the entire assembly, not just the glass or door leaf.

F. For this standard it can be assumed that the rating of a prime-and-storm window combination is STC 36 provided the rating of the *storm* window alone is at least STC 29 and the airspace between the prime and storm window is at least 1-3/4" for all sashes.

G. For this standard it can be assumed that the rating of a prime-and-storm door combination is STC 37 provided the rating of the *storm* door alone is at least STC 30 and the airspace between the prime and storm door is at least 2".

H. In order to achieve the STC ratings specified herein special measures are necessary to install doors and windows. These include the use of non-hardening (acoustical) caulk at all hidden surfaces, flexible caulk at all exposed surfaces, and solid continuous blocking to fill all voids over 1/4" around windows and doors.

I. The phrase "Total Exterior Wall Area" as used in this standard includes the exterior wall area of the room as well as the area of all windows and doors contained within the exterior walls.

J. The phrase "Roof" as used in this standard shall refer to a ceiling attached to the bottom edge of roof structural members that are at least 14" deep (the depth is the clear distance between the ceiling gypsumboard and the roof deck) for the portion of the structural member over a living space. The use of shallower roof framing is not allowed without a written statement from a qualified acoustical consultant (see section B above). The best acoustical performance is achieved when there are horizontal ceilings, an accessible attic space above, and a sloped roof.

K. The phrase "Exposed Floor" in this standard shall refer to the floor of a house elevated above the ground without the use of a crawl space. This includes primarily beach houses on pylons.

L. It is difficult to predict the acoustical performance of open plan spaces. Adjacent habitable spaces that are fully open to each other shall be grouped and treated as one room. When the rooms are only partially open to each other, group them if the partitions separating the rooms are more than 30% open.

M. The number of exterior walls is a parameter that affects the acoustical performance of the room. If the exterior wall is over 12 feet tall it shall count as two exterior walls. Partial walls count as one exterior wall.

N. The phrase "wood-framed walls" refers to any walls that do not have brick veneer, concrete blocks, or poured concrete.

### SECTION 3: BUILDING REQUIREMENTS FOR A MINIMUM NLR OF 20 dB.

**A. Exterior Walls**

1. The interior surface of exterior walls shall be gypsum board at least 1/2 inch thick, or an alternative material of equal surface mass.

2. For wood-framed walls: Fiberglass, mineral fiber, or cellulose batt or blanket insulation shall be installed

continuously and completely throughout the stud cavity. Batts or blankets should be held firmly in place between the studs, with fasteners if necessary, to prevent sagging; however, packing the insulation such that it is compressed may *slightly reduce* its acoustical (and thermal) performance.

3. Insulated concrete form (ICF) or masonry walls, where present, shall contain at least 4" thick normal weight concrete or masonry throughout the surface of the wall.

**B. Windows**

1. For rooms that have at least one wood-framed exterior wall: Windows shall have a laboratory sound transmission class rating of at least STC 28.

2. For rooms that have all ICF exterior walls: If the exterior windows and doors together comprise 75% or more of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 28.

**C. Doors**

1. Exterior doors, and interior doors between occupied spaces and attached garages, unfinished attics, and other non-habitable spaces with an exterior wall or ceiling, shall be fully weatherstripped.

**D. Roof-Ceiling Assembly**

1. Gypsum board ceilings at least 1/2 inch thick shall be provided at top floor. Ceilings at top floor shall be substantially airtight with a minimum number of penetrations.

2. Fiberglass, mineral fiber, or cellulose insulation shall be installed continuously and completely throughout the ceiling joist cavity to a depth of at least 10 inches. Batt or blanket insulation shall be used at sloped ceilings.

3. Roof framing members shall be at least 14" deep for their entire span.

4. Attic access panels shall be constructed of 3/4" thick plywood and shall have continuous neoprene perimeter bulb seals. Pull-down attic stairs shall have moveable or operable covers constructed of 3/4" thick plywood and shall have continuous neoprene perimeter bulb seals.

5. Skylights shall not be provided.

**E. Floors, Foundations and Basements**

1. For houses elevated on pylons: Use plywood or OSB at least 1/2" thick at the underside of the floor joists with at least 10" thick fiberglass, mineral fiber, or cellulose insulation.

2. If crawl spaces do not have masonry walls, a massive barrier panel must be used as a skirt connecting the bottom of the walls to the ground. 2" thick precast concrete panels are ideal barrier skirts. Alternatively, 2x4 pressure-treated wood studs with ¾" pressure-treated plywood on each side may be used, as long as the joints between the plywood are covered with batten strips. In flood zones use double-swing plywood flood gates in lieu of vents to the extent allowable by code.





**F. Ventilation and Wall Penetrations**

1. In-window, through-wall, or through-floor air-conditioning, ventilating, or heating units shall not be used.

2. Through-the-wall/door mailboxes or mail slots shall not be used.

3. A mechanical ventilation system shall be installed that will provide the minimum air circulation and fresh air supply requirements for various uses in occupied rooms, as specified in the North Carolina state building code, without the need to open any windows, doors, or other openings to the exterior.

4. Gravity vent openings in attics shall not exceed the code minimum in number and size.

5. If an attic fan is used for forced ventilation, the attic inlet and discharge openings shall be fitted with sheet metal transfer ducts of at least 20 gauge steel at least 5 feet long with at least one 90° bend.

6. All vent ducts, including those for bathroom exhaust fans and dryers, connecting the interior space to the outdoors shall be rigid metal and contain at least two 90° bends, or one 90° bend and a total length of at least 20 feet (or the maximum length allowed by the dryer manufacturer).

7. Vented domestic range fans shall be not used.

8. Vented wood stoves shall not be used. Where vented fireplaces or vented gas-powered prefabricated units are used provide acoustical chimney top dampers and use tight-fitting 1/4" tempered glass fireplace doors.

9. Vented fuel-burning appliances (e.g., gas dryers, gas fireplaces, oil or gas furnaces, and gas water heaters) shall not be located in habitable spaces (e.g, kitchens, living rooms, bedrooms, etc.). Vent ducts for fuel-burning appliances in non-habitable spaces (e.g., closets and attics) shall have double-wall sheet metal construction.

10. Whole-house fans shall not be provided.

11. All ducts in attics shall be rigid metal.

12. Dryers shall be located in closets or other non-habitable spaces. Dryer ducts shall be rigid metal.

**SECTION 4: BUILDING REQUIREMENTS FOR A MINIMUM NLR OF 25 dB.**

**A. Exterior walls**

1. The interior surface of exterior walls shall be gypsum board at least 1/2 inch thick, or an alternative material of equal surface mass.

2. For wood-framed walls: Fiberglass, mineral fiber, or cellulose batt or blanket insulation shall be installed continuously and completely throughout the stud cavity. Batts or blankets should be held firmly in place between the studs, with fasteners if necessary, to prevent sagging; however, packing the insulation such that it is compressed may slightly reduce its acoustical (and thermal) performance.

3. Insulated concrete form (ICF) or masonry walls, where present, shall contain at least 4" thick normal weight concrete or masonry throughout the surface of the wall.

**B. Windows**

1. For rooms with at least one wood-framed wall:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 25% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 26.
      ii. If the exterior windows and doors together comprise 25-40% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 28.
      iii. If the exterior windows and doors together comprise more than 40% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 30.

   b. If there are two or more exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 28.
      ii. If the exterior windows and doors together comprise 20-35% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 30.
      iii. If the exterior windows and doors together comprise more than 35% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 32..

2. For rooms with all ICF walls:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 40% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 26.
      ii. If the exterior windows and doors together comprise 40% or more of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 30.

   b. If there are two or more exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 26.
      ii. If the exterior windows and doors together comprise 20-30% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 28.
      iii. If the exterior windows and doors together comprise 30-75% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 30.
      iv. If the exterior windows and doors together comprise more than 75% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 32.





**C. Doors**

1. For rooms with at least one wood-framed wall:

   a. If there is only one exterior wall: If exterior windows and doors together comprise more than 40% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 29.

   b. If there are more than one exterior wall: If exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 29.

2. For rooms with all ICF walls:

   a. If there is only one exterior wall and the exterior windows and doors together comprise 40% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 29.

   b. If there are more than one exterior wall and the exterior windows and doors together comprise 30% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 29.

3. Interior doors between occupied spaces and attached garages, unfinished attics, or other non-habitable spaces with an exterior wall or ceiling shall have a laboratory sound transmission class rating of at least STC 23.

**D. Roof-Ceiling Assembly**

1. Gypsum board ceilings at least 1/2 inch thick shall be provided at top floor. Ceilings at top floor shall be substantially airtight with a minimum number of penetrations. Where recessed lights are used in top-floor ceilings provide a gypsum board enclosure around the lighting fixture and seal the gypsum board joints with caulk or joint compound.

2. Fiberglass, mineral fiber, or cellulose insulation shall be installed continuously and completely throughout the ceiling joist cavity to a depth of at least 10 inches. Batt or blanket insulation shall be used at sloped ceilings.

3. Roof framing members shall be at least 14" deep for their entire span.

4. Attic access panels shall be constructed of 3/4" thick plywood and shall have continuous neoprene perimeter bulb seals. Pull-down attic stairs shall have moveable or operable covers constructed of 3/4" thick plywood and shall have continuous neoprene perimeter bulb seals.

5. Skylights shall not be provided.

**E. Floors and Foundations**

1. For houses elevated on pylons: Use plywood or OSB at least 1/2" thick at the underside of the floor joists with at least 10" thick fiberglass, mineral fiber, or cellulose insulation.

2. If crawl spaces do not have masonry walls, a massive barrier panel must be used as a skirt connecting the bottom of the walls to the ground. 2" thick precast concrete panels are ideal barrier skirts. Alternatively, 2x4 pressure-treated wood studs with ¾" pressure-treated plywood on each side may be used, as long as the joints between the plywood are covered with batten strips. In flood zones use double-swing plywood flood gates in lieu of vents to the extent allowable by code.

**F. Ventilation and Wall and Roof Penetrations**

1. In-window, through-wall, or through-floor air-conditioning, ventilating, or heating units shall not be used.

2. Through-the-wall/door mailboxes or mail slots shall not be used.

3. A mechanical ventilation system shall be installed that will provide the minimum air circulation and fresh air supply requirements for various uses in occupied rooms, as specified in the North Carolina state building code, without the need to open any windows, doors, or other openings to the exterior.

4. Gravity vent openings in attics shall not exceed the code minimum in number and size.

5. If an attic fan is used for forced ventilation, the attic inlet and discharge openings shall be fitted with sheet metal transfer ducts of at least 20 gauge steel at least 5 feet long with at least one 90° bend.

6. All vent ducts, including those for bathroom exhaust fans and dryers, connecting the interior space to the outdoors shall be rigid metal and contain at least two 90° bends, or one 90° bend and a total length of at least 20 feet (or the maximum length allowed by the dryer manufacturer).

7. Vented domestic range fans shall be not used.

8. Vented wood stoves shall not be used. Where vented fireplaces or vented gas-powered prefabricated units are used provide acoustical chimney top dampers and use tight-fitting 1/4" tempered glass fireplace doors.

9. Vented fuel-burning appliances (e.g., gas dryers, gas fireplaces, oil or gas furnaces, and gas water heaters) shall not be located in habitable spaces (e.g, kitchens, living rooms, bedrooms, etc.). Vent ducts for fuel-burning appliances in non-habitable spaces (e.g., closets and attics) shall have double-wall sheet metal construction.

10. Whole-house fans shall not be provided.

11. All ducts in attics shall be rigid metal.

12. Dryers shall be located in closets or other non-habitable spaces. Dryer ducts shall be rigid metal.





**SECTION 5: BUILDING REQUIREMENTS FOR A MINIMUM NLR OF 30 dB.**

**A. Exterior Walls**

1. The interior surface of exterior walls shall be gypsum board at least 1/2 inch thick, or an alternative material of equal surface mass.

2. For wood-framed walls:

   a. Fiberglass, mineral fiber, or cellulose batt or blanket insulation shall be installed continuously and completely throughout the stud cavity. Batts or blankets should be held firmly in place between the studs, with fasteners if necessary, to prevent sagging; however, packing the insulation such that it is compressed may slightly reduce its acoustical (and thermal) performance.

   b. If there is one only one exterior wall: If exterior windows and doors together comprise 30% or more of the Total Exterior Wall Area, single-leaf resilient channels shall be used between the studs and gypsum board.

   c. If there are two or more exterior walls single-leaf resilient channels shall be used between the studs and gypsum board.

3. Insulated concrete form (ICF) or masonry walls, where present, shall contain at least 4" thick normal weight concrete or masonry throughout the surface of the wall.

**B. Windows**

1. For rooms with at least one wood-framed wall:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 32.
      ii. If the exterior windows and doors together comprise 20-30% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.
      iii. if the exterior windows and doors together comprise 30-50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 32.
      iv. if the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.

   b. If there are two exterior walls: The windows shall have a laboratory sound transmission class rating of at least STC 34.

   c. If there are three or more exterior walls:
      i. If the exterior windows and doors together comprise 70% or less of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.
      ii. If the exterior windows and doors together comprise more than 70% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 36.

2. For rooms with all ICF walls:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 30.
      ii. If the exterior windows and doors together comprise 20 to 50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 32.
      iii. If the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.

   b. If there are two exterior walls: The windows shall have a laboratory sound transmission class rating of at least STC 34.

   c. If there are three or more exterior walls:
      i. If the exterior windows and doors together comprise 70% or less of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.
      ii. If the exterior windows and doors together comprise more than 70% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 36.

**C. Doors**

1. For rooms with at least one wood-framed wall:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      ii. If the exterior windows and doors together comprise 20-30% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.
      iii. If the exterior windows and doors together comprise 30-50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      iv. If the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.

   b. If there are two exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.

   c. If there are three or more exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.





2. For rooms with all ICF walls:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 29.
      ii. If the exterior windows and doors together comprise 20 to 50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      iii. If the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.

   b. If there are two exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.

   c. If there are three or more exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 31.
      ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.

3. Interior doors between occupied spaces and attached garages, unfinished attics, or other non-habitable spaces with an exterior wall or ceiling shall have a laboratory sound transmission class rating of at least STC 29.

**D. Roof-Ceiling Assembly**

1. Ceilings consisting of at least two layers of at least 1/2-inch thick gypsum board shall be provided at top floor. Ceilings at top floor shall be substantially airtight with a minimum number of penetrations. Where recessed lights are used in top-floor ceilings provide a gypsum board enclosure around the lighting fixture and seal the gypsum board joints with caulk or joint compound.

2. Fiberglass, mineral fiber, or cellulose insulation shall be installed continuously and completely throughout the ceiling joist cavity to a depth of at least 10 inches. Batt or blanket insulation shall be used at sloped ceilings.

3. Roof framing members shall be at least 14″ deep for their entire span.

4. Attic access panels shall be constructed of 3/4″ thick plywood and shall have continuous neoprene perimeter bulb seals. Pull-down attic stairs shall have moveable or operable covers constructed of 3/4″ thick plywood and shall have continuous neoprene perimeter bulb seals.

5. Skylights shall not be provided.

**E. Floors and Foundations**

1. For houses elevated on pylons: Use plywood or OSB at least 1/2" thick at the underside of floor joists that are at least 14" deep with at least 10" thick fiberglass, mineral fiber, or cellulose insulation.

2. If crawl spaces do not have masonry walls, a massive barrier panel must be used as a skirt connecting the bottom of the walls to the ground. 2" thick precast concrete panels are ideal barrier skirts. Alternatively, 2x4 pressure-treated wood studs with ¾" pressure-treated plywood on each side may be used, as long as the joints between the plywood are covered with batten strips. Use acoustical louvers for all vents. In flood zones use double-swing plywood flood gates in lieu of vents to the extent allowable by code.

**F. Ventilation and Wall and Roof Penetrations**

1. In-window, through-wall, or through-floor air-conditioning, ventilating, or heating units shall not be used.

2. Through-the-wall/door mailboxes or mail slots shall not be used.

3. A mechanical ventilation system shall be installed that will provide the minimum air circulation and fresh air supply requirements for various uses in occupied rooms, as specified in the North Carolina state building code, without the need to open any windows, doors, or other openings to the exterior.

4. Gravity vent openings in attics shall not exceed the code minimum in number and size.

5. If an attic fan is used for forced ventilation, the attic inlet and discharge openings shall be fitted with sheet metal transfer ducts of at least 20 gauge steel at least 5 feet long with at least one 90° bend.

6. All vent ducts, including those for bathroom exhaust fans and dryers, connecting the interior space to the outdoors shall be rigid metal and contain at least two 90° bends, or one 90° bend and a total length of at least 20 feet (or the maximum length allowed by the dryer manufacturer).

7. Vented domestic range fans shall be not used.

8. Vented fireplaces, wood stoves, or gas-powered prefabricated units shall not be used.

9. Vented fuel-burning appliances (e.g., gas dryers, gas fireplaces, oil or gas furnaces, and gas water heaters) shall not be located in habitable spaces (e.g, kitchens, living rooms, bedrooms, etc.). Vent ducts for fuel-burning appliances in non-habitable spaces (e.g., closets and attics) shall have double-wall sheet metal construction.

10. Whole-house fans shall not be provided.

11. All ducts in attics shall be rigid metal.

12. Dryers shall be located in closets or other non-habitable spaces. Dryer ducts shall be rigid metal.





**SECTION 6: BUILDING REQUIREMENTS FOR A MINIMUM NLR OF 35 dB.**

**A. Exterior Walls**

1. The interior surface of exterior walls shall be gypsum board at least 1/2 inch thick, or an alternative material of equal surface mass.

2. For wood-framed walls:

   a. Fiberglass, mineral fiber, or cellulose batt or blanket insulation shall be installed continuously and completely throughout the stud cavity. Batts or blankets should be held firmly in place between the studs, with fasteners if necessary, to prevent sagging; however, packing the insulation such that it is compressed may slightly reduce its acoustical (and thermal) performance.

   b. If there is one only one exterior wall:
      i. If exterior windows and doors together comprise less than 25% of the Total Exterior Wall Area single-leaf resilient channels shall be used between the studs and gypsum board.
      ii. If exterior windows and doors together comprise 25% or more of the Total Exterior Wall Area the studs shall be 2x4 studs staggered on 2x6 plates (if the studs need to be 2x6 for structural reasons, use 2x6 studs staggered on 2x8 plates).

   c. If there are two or more exterior walls:
      i. If exterior windows and doors together comprise less than 15% of the Total Exterior Wall Area single-leaf resilient channels shall be used between the studs and gypsum board.
      ii. If exterior windows and doors together comprise 15 to 30% of the Total Exterior Wall Area the studs shall be 2x4 studs staggered on 2x6 plates (if the studs need to be 2x6 for structural reasons, use 2x6 studs staggered on 2x8 plates).
      iii. If exterior windows and doors together comprise more than 30% of the Total Exterior Wall Area the studs shall be 2x4 studs staggered on 2x6 plates (if the studs need to be 2x6 for structural reasons, use 2x6 studs staggered on 2x8 plates), and two layers of 1/2" gypsum board shall be provided at the interior surface of the room.

3. Insulated concrete form (ICF) or masonry walls, where present, shall contain at least 4" thick normal weight concrete or masonry throughout the surface of the wall.

**B. Windows**

1. For rooms with at least one wood-framed wall:

   a. If there is only one exterior wall:
      i. If the exterior windows and doors together comprise less than 25% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 36.
      ii. If the exterior windows and doors together comprise 25% or more of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 40.

   b. If there are two or more exterior walls:
      i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 38.

ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 42.

2. For rooms with all ICF walls:

a. If there is only one exterior wall:
   i. If the exterior windows and doors together comprise less than 15% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 34.
   ii. If the exterior windows and doors together comprise 15 to 25% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 36.
   iii. If the exterior windows and doors together comprise 25 to 50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 38.
   iv. If the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 40.

b. If there are two or more exterior walls:
   i. If the exterior windows and doors together comprise less than 20% of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 40.
   ii. If the exterior windows and doors together comprise 20% or more of the Total Exterior Wall Area the windows shall have a laboratory sound transmission class rating of at least STC 44.

## C. Doors

1. For rooms with at least one wood-framed wall:

a. If there is only one exterior wall:
   i. If the exterior windows and doors together comprise less than 25% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.
   ii. If the exterior windows and doors together comprise 25% or more of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 40.

b. If there are two or more exterior walls:
   i. If the exterior windows and doors together comprise 30% or less of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 37.
   ii. If the exterior windows and doors together comprise more than 30% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 40.

2. For rooms with all ICF walls:

a. If there is only one exterior wall:
   i. If the exterior windows and doors together comprise less than 25% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 34.
   ii. If the exterior windows and doors together comprise 25 to 50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 37.
   iii. If the exterior windows and doors together comprise more than 50% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 40.





b. If there are two or more exterior walls:
   i. If the exterior windows and doors together comprise less than 15% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 37.
   ii. If the exterior windows and doors together comprise 15 to 30% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 40.
   iii. If the exterior windows and doors together comprise more than 30% of the Total Exterior Wall Area the doors shall have a laboratory sound transmission class rating of at least STC 43.

3. Interior doors between occupied spaces and attached garages, unfinished attics, or other non-habitable spaces with an exterior wall or ceiling shall have a laboratory sound transmission class rating of at least STC 29.

## D. Roof-Ceiling Assembly

1. Gypsum board ceilings at least 1/2 inch thick shall be provided at top floor. Single-leaf resilient channels shall be used to hang the gypsum board at top floor. Ceilings at top floor shall be substantially airtight with a minimum number of penetrations. Recessed lights shall not be used in top-floor ceilings.

2. Fiberglass, mineral fiber, or cellulose insulation shall be installed continuously and completely throughout the ceiling joist cavity to a depth of at least 10 inches. Batt or blanket insulation shall be used at sloped ceilings.

3. Roof framing members shall be at least 14″ deep for their entire span.

4. Attic access panels shall be constructed of 3/4″ thick plywood and shall have continuous neoprene perimeter bulb seals. Pull-down attic stairs shall have moveable or operable covers constructed of 3/4″ thick plywood and shall have continuous neoprene perimeter bulb seals.

5. Skylights shall not be provided.

## E. Floors and Foundations

1. For houses elevated on pylons: Use plywood or OSB at least 1/2″ thick at the underside of floor joists that are at least 14″ deep with at least 10″ thick fiberglass, mineral fiber, or cellulose insulation.

2. If crawl spaces do not have masonry walls, a massive barrier panel must be used as a skirt connecting the bottom of the walls to the ground. 2″ thick precast concrete panels are ideal barrier skirts. Alternatively, 2x4 pressure-treated wood studs with ¾″ pressure-treated plywood on each side may be used, as long as the joints between the plywood are covered with batten strips. Use acoustical louvers for all vents. In flood zones use double-swing plywood flood gates in lieu of vents to the extent allowable by code.

## F. Ventilation and Wall and Roof Penetrations

1. In-window, through-wall, or through-floor air-conditioning, ventilating, or heating units shall not be used.

2. Through-the-wall/door mailboxes or mail slots shall not be used.

3. A mechanical ventilation system shall be installed that will provide the minimum air circulation and fresh

air supply requirements for various uses in occupied rooms, as specified in the North Carolina state building code, without the need to open any windows, doors, or other openings to the exterior.

4. Gravity vent openings in attics shall not exceed the code minimum in number and size.

5. If an attic fan is used for forced ventilation, the attic inlet and discharge openings shall be fitted with sheet metal transfer ducts of at least 20 gauge steel at least 5 feet long with at least one 90° bend.

6. All vent ducts, including those for bathroom exhaust fans and dryers, connecting the interior space to the outdoors shall be rigid metal and contain at least two 90° bends, or one 90° bend and a total length of at least 20 feet (or the maximum length allowed by the dryer manufacturer).

7. Vented domestic range fans shall be not used.

8. Vented fireplaces, wood stoves, or gas-powered prefabricated units shall not be used.

9. Vented fuel-burning appliances (e.g., gas dryers, gas fireplaces, gas furnaces, and gas water heaters) shall not be located in habitable spaces (e.g, kitchens, living rooms, bedrooms, etc.). Vent ducts for fuel-burning driven appliances in non-habitable spaces (e.g., closets and attics) shall have double-wall sheet metal construction.

10. Whole-house fans shall not be provided.

11. All ducts in attics shall be rigid metal.

12. Dryers shall be located in closets or other non-habitable spaces. Dryer ducts shall be rigid metal.





## APPENDIX B

## DESIGN REVIEW CHECKLIST

# Appendix B
# Design Review Checklist

This checklist will be useful for plan reviewers in determining whether a new house design complies with the recommendations contained in the Design Guide. Various sections of the Design Guide are referenced below.

1. Required NLR. Determine the required Noise Level Reduction (NLR) based on the outdoor noise (DNL) zone or from the local zoning ordinance if the community has adopted one.
2. List of Rooms. Develop a list of rooms for which the recommendations of the Design Guide apply. Determine which rooms are habitable and have any exterior exposure through the roof/ceiling assembly, walls, windows, or doors. For a discussion of habitable rooms see section 1.1. The recommendations apply to all habitable rooms, to all rooms that open to habitable rooms, and to all attics and crawl spaces. Group rooms of open plan spaces if the partitions separating the rooms are more than 30% open.
3. Determine Recommendations. For each applicable room, determine the recommendations. Appendix A includes a complete list of recommendations, while Table 4-1 provides a summary of the key recommendations for walls, windows, doors, roofs, and floors. Additional optional treatments for attic and crawl space vent baffles and louvers are included in section 3.6 and 3.7. For a discussion of the use of Table 4-1 see section 4. Consider the recommendations for walls, windows, doors, roofs, and floors, as well as the following:
   a. Through-wall, through-floor, or in-window heating, ventilating, or air-conditioning units
   b. Through-wall or through-door mail slots
   c. Active fresh-air ventilation
   d. Attic gravity vents
   e. Attic fans
   f. Bath exhaust fans
   g. Dryer location
   h. Dryer exhaust duct
   i. Vented range fans
   j. Vented fireplaces, wood stoves, and gas-powered prefabricated units
   k. Fuel-burning appliance (boiler, furnace, water heater, dryer, etc.) combustion exhaust ducts
   l. Whole-house fans
   m. Skylights
   n. Combustion air enforcers
   o. Attic access panels
   p. Pull-down attic stair covers
   q. Heating, ventilating, and air-conditioning ducts in the attic
   r. Attic vent baffles or louvers (optional)
   s. Crawl space vent baffles or louvers (optional)
4. Resilient Channels. If resilient channels are proposed, verify that they are flexible and single-leaf. Alternatively, rigid channels in combination with resilient sound isolation clips (manufactured by PAC International) may be used. All resilient channels and resilient sound isolation clips must be attached directly to studs or joists, and not to interior sheets of OSB, plywood, or gypsum board.
5. Implement Recommendations. Verify that the recommendations have been incorporated into the house design.
6. Window and Door STC Test Reports. For windows and doors, a complete laboratory acoustical test report





performed in accordance with ASTM E 90 for the proposed product is required (don't forget about doors between garages and the house meeting the requirements of Appendix A):
   a. Verify that the report has a complete product description noting glazing type, thickness and spacing; prime and storm frame and sash material and thickness; the operational configuration (hung, sliding, etc.); and the weatherstripping type. Reports with portions, such as proprietary product descriptions, blacked out are not acceptable. If the report has a product model number but does not have a complete product description, obtain supplemental product shop drawings.
   b. Verify that the report is presented in its entirety.
   c. Verify that the report was prepared by an independent laboratory accredited through the National Voluntary Laboratory Accreditation Program (NVLAP).
   d. Verify that the test was performed in a laboratory in accordance with standard ASTM E 90 as opposed to in the field (in accordance with standard ASTM E 336, E 966, or some other standard).
   e. Verify that the test was performed recently enough. This determination could consider whether material suppliers are the same now as when the test was performed, whether the fabrication location is the same, whether fabrication equipment is the same, the age of fabrication equipment, etc. Ideally, the test would have been performed in the past five years; however, due to the cost of acoustical tests a relaxing of this requirement might be appropriate in some cases.
   f. Verify that the test was performed on an operable (if the proposed product is operable) complete door or window assembly. Unacceptable tests are those performed using only the glass of a window, not the complete window, or using windows or doors glued, caulked, or nailed closed.
   g. Verify that the proposed windows are the same as the one that was described in the test report. If a tested window had a storm window the proposed one must also. The model numbers, the glazing thickness and spacing, the sash construction (welded or bolted), and the frame and sash material and thickness must be the same as for the tested product. However, it is acceptable for the proposed window to have internal or applied muntins, glass obscuration, different hardware, and different screens without affecting the acoustical performance. Generally, fixed (picture) windows perform best, horizontally operated (sliding/rolling) windows are next best, vertically operated (hung) windows are next, and swinging (awning/hopper/casement) windows are the worst. The proposed window must be the same configuration as the tested window or at least be expected to perform better than the tested window based on the previous sentence.
   h. Verify that the proposed doors are the same as the one that was described in the test report. The door hardware, applied moldings, and screen doors are irrelevant. However, the glazing type, weatherstripping type, bottom seal type, threshold or saddle type, and door leaf construction must be the same as the tested product, and ideally, the general glazing area should be the same.
   i. Door and window sidelights and transoms may be tested with the doors or windows or alone (glass only), whichever is more convenient. Tests for glass alone are acceptable for demonstrating the performance of these products; the test for glass could even be an old test referenced in a textbook. For example, two panes of double strength glass (1/8" thick) separated by a 3/8" airspace can achieve approximately STC
7. Acoustical Consulting. The applicant may hire a qualified acoustical consultant to perform a detailed acoustical analysis of the proposed house. If the report is submitted it could be reviewed in lieu of steps 3 through 6 above. Some qualifications of acoustical consultants to consider include whether the firm is a member of the National Council of Acoustical Consultants (NCAC), whether the engineer is a Professional Engineer (PE), whether the engineer is a member of the Institute of Noise Control Engineers (INCE), whether the engineer has a bachelors degree in engineering from an ABET-accredited college or university, how many years of experience the engineer has, and whether the engineer has experience evaluating the sound insulating performance of buildings.

APPENDIX C

CONSTRUCTION INSPECTION CHECKLIST





## Appendix C
## Construction Inspection Checklist

This checklist will be useful for construction inspectors in determining whether the recommendations contained in the Design Guide were implemented. Various sections of the Design Guide are referenced below.

2. Collect the notes of the plan reviewer to determine the applicable recommendations for each room of the house.
3. For windows and doors, compare the installed product to the description in the acoustical test report to ensure that the correct product (and therefore the correct STC rating) was used in each room. If the report listed product model numbers but did not have a complete description, compare the installed product to the product shop drawings. Focus on the glazing type, thickness and spacing; prime and storm frame and sash material and thickness; the operational configuration (hung, sliding, etc.); the weatherstripping and bottom door seal; and the door saddle or threshold type.
4. Don't forget about doors between garages and the house meeting the requirements of Appendix A.
5. Inspect the door and window installation. Verify that there is no racking of the frame causing gaps to form between the sashes or door panels and the frame. Voids between the rough opening and the frame greater than 1/4" must be filled with solid wood blocking, as opposed to batt insulation. Voids between the rough opening and the frame less than 1/4" may be filled with batt insulation. Hidden (protected) gaps must be filled with non-hardening (acoustical) sealant at the interior and exterior. Exposed gaps must be filled with flexible caulk at the interior and exterior.
6. Verify that the modifications for walls and ceilings have been implemented in each room.
7. Verify that all wood-framed walls have fiberglass, mineral fiber, or cellulose batt or blanket insulation, and never blown-in insulation.
8. If resilient channels are specified for walls or ceilings verify that they are installed in accordance with the channel manufacturer's instructions. Common mistakes are:
    a. *Using drywall screws that are so long* that the screws used to hang the gypsum board contact the wood framing, thereby allowing noise to transmit through the screw. Contact is bad, even if the screw does not grab the wood. Use 7/8" (not 1") long screws with 1/2" gypsum board.
    b. *Using closer channel spacing*. The channel manufacturer specifies the maximum allowable resilient channel spacing based on the gypsum board weight for walls and ceilings. For acoustical purposes, use the exact maximum allowable, not a closer spacing. Typically, this is 24" on center.
    c. *Using rigid channels.* The channels must be single-leaf resilient channels, not rigid channels. A resilient channel is typically 25-gage steel, shaped like half of a hat channel, with holes in the web.
    d. *Installing resilient channels over a solid sheet material.* It is never acceptable to attach OSB, plywood, or gypsum board directly to the studs or joists and then attach resilient channels (or resilient sound isolation clips) to that board with an additional layer of gypsum board. Whenever resilient channels are used they must always be attached directly to the studs or joists. If it were necessary to use an interior layer of OSB or plywood for structural reasons, resilient channels would not be effective; in this case, use ICF walls, furr out an interior wall, or have an acoustical consultant propose an alternative design.
    e. *Orienting the channels incorrectly.* The channels were designed to have the stud-side leg lower than the gypsum board-side leg. This makes it more likely that the gypsum board will be floating resiliently.
    f. *Blocking at the base.* To provide kick-resistance at the base of walls and to allow attachment of solid base molding a filler strip of gypsum board is sometimes used between the studs and the gypsum board panels. This is acceptable, but will reduce the acoustical performance of the wall.

9. Staggered studs consist of 2x4 studs staggered on a 2x6 plate, or 2x6 studs staggered on a 2x8 base. If staggered studs are specified for walls verify:
    a. No interior studs contact an exterior stud; the two rows of studs must be independent. Of course, at windows and doors it is necessary to use single studs the same width as the plate; this unfortunately diminishes the acoustical performance.
    b. Insulation is not compressed. For example, do not use a single piece of R-19 batt insulation packed between a stud and gypsum board.
    c. Interior boxes (outlets, switches, etc.) must never contact exterior studs, and exterior boxes must never contact interior studs.
    d. Stud spacing should be maximized. Where feasible for strength use 16 or 24 inch spacing for both the interior and exterior rows of studs.
10. Verify that all exterior wall and ceiling gypsum board is at least 1/2" thick.
11. If two layers of gypsum board are specified for walls or ceilings verify that the layers are each at least 1/2" thick.
12. If ICF walls are used verify that the concrete is at least as massive as 4" thick normal weight concrete.
13. Verify that attic insulation is at least 10" thick cellulose, mineral fiber, fiberglass.
14. Above sloped ceilings use only batt insulation.
15. Verify that there is at least 14" clear space between the bottom of the roof deck and the top of the ceiling, for the entire area over habitable rooms.
16. If "deep" floor trusses are specified in Table 4-1 and Appendix A for the floors of elevated (beach) houses:
    a. Verify that the depth of the trusses is at least 14" throughout the span.
    b. Verify that the batt insulation is at least 10" thick.
    c. Verify that the bottom cords of trusses are covered with nominal 1/2" (min.) OSB or plywood.
17. If crawl spaces do not have masonry walls, verify that a massive barrier panel (masonry or 3/4" nominal plywood) is used as a skirt connecting the bottom of the walls to the ground.
18. For crawl spaces in flood zones use double-swing 3/4" thick plywood doors in lieu of open louvers where allowable by code.
19. Verify that all miscellaneous building penetrations are addressed in accordance with the recommendations in Appendix A including:
    a. Through-wall, through-floor, or in-window heating, ventilating, or air-conditioning units
    b. Through-wall or through-door mail slots
    c. Active fresh-air ventilation
    d. Attic gravity vents
    e. Attic fans
    f. Bath exhaust fans
    g. Dryer location
    h. Dryer exhaust duct
    i. Vented range fans
    j. Vented fireplaces, wood stoves, and gas-powered prefabricated units
    k. Fuel-burning appliance (boiler, furnace, water heater, dryer, etc.) combustion exhaust ducts
    l. Whole-house fans
    m. Skylights
    n. Combustion air enforcers
    o. Attic access panels
    p. Pull-down attic stair covers
    q. Heating, ventilating, and air-conditioning ducts in the attic
    r. Attic vent baffles or louvers (optional)
    s. Crawl space vent baffles or louvers (optional)





## APPENDIX D

## MANUFACTURERS OF ACOUSTICAL MATERIALS

# Appendix D
## Manufacturers of Acoustical Materials

This list represents a partial list of manufacturers of specialty acoustical products. Other manufacturers not listed may have comparable products. The list below does not imply a product endorsement or recommendation by Wyle Laboratories.

INSULATION

CertainTeed
Headquarters
P.O. Box 860 or
750E Swedesford Rd.
Valley Forge, PA 19482
Tel: 800-233-8990
www.certainteed.com

Johns Manville
P.O. Box 5108
Denver, CO 80217-5108
Tel: 800-654-3103
www.jm.com

Knauf Fiberglass
One Knaff Drive
Shelbyville, IN 46176
Tel: 800-825-4434
Fax: 317-398-3675

Owens Corning Fiberglass Corp.
One Owens Corning Parkway
Toledo, OH 43659
Tel: 800-438-7465 (800-GET-PINK)
www.owenscorning.com

ACOUSTICALLY TESTED DOORS

Algoma Hardwoods
1001 Perry Street
Algoma, WI 54201
Tel: 800-678-8910
www.algomahardwoods.com

Armaclad, Inc.
P.O. Box 70
Waynesboro, PA 17268
Tel: 800-541-6666
www.armaclad.com

Buell Door Company
5200 East Grand Ave.
Suite 500
Dallas, TX 75223
Tel: 800-556-0155
www.buelldoor.com

Ceco Door Products
9159 Telecom Drive
Milan, TN 38358
Tel: 888-232-6366
www.cecodoor.com

Eggers Industries
P.O. Box 1050
Neenah, WI 54957-1050
Tel: 920-722-6444
www.eggersindustries.com

Frieger Specialty Products
9880 Gregg Road
Pico Rivera, CA 90660
Tel: 866-203-5060
www.kriegerproducts.com

Graham Architectural Products
1551 Mt. Rose Avenue
York, PA 17403-2909
Tel: 800-755-6274
www.grahamarch.com

Harvey Industries, Inc.
1400 Main Street
Waltham, MA 02154
Tel: 800-942-7839
www.harveyind.com

Industrial Acoustics Company
1160 Commerce Avenue
Bronx, NY 10462
Tel: 718-931-8000
www.industrialacoustics.com

Jeld-wen
19618 Wildwood Drive
West Linn, OR 97068
Tel: 877-783-2057
www.jeld-wen.com





ACOUSTICALLY TESTED DOORS - *Concluded*

Jamison Door Company
55 J.V. Jamison Drive
P.O. Box 70
Hagerstown, MD 21741-0070
Tel: 800-532-3667
www.jamison-door.com

Krieger Specialty Products
4880 Gregg Road
Pico Rivera, CA 90660
Tel: 866-203-5060
www.kriegerproducts.com

Larson Doors
Tel: 800-352-3360
www.larsondoors.com

Marshfield Doors Systems, Inc.
1401 East 4th Street
Marshfield, WI 54449-7780
Tel: 800-869-3667
www.marshfielddoors.com

Mohawk Flush Doors, Inc.
980 Point Township Road
P.O. Box 112
Northumberland, PA 17857-0112
Tel: 570-473-3557
www.mohawkdoors.com

Mon-Ray, Inc.
801 Boone Avenue North
Minneapolis, MN 55427-4432
Tel: 800-544-3646
www.monray.com

Overly Door Company
574 West Otterman St.
Greensburg, PA 15601
Tel: 800-979-7300
www.overly.com

PGT Industries, Inc.
Tel: 877-550-6006
www.pgtindustries.com

P.H. Tech Corp.
144 Ferry Street
Buncher Industrial Park
Leetsdale, PA 15056
www.phtech.ca

Pioneer Industries
171 South Newman Street
Hackensack, NJ 07601
Tel: 201-933-1900
www.pioneerindustries.com

Rehau Incorporated
P.O. Box 1706
Leesburg, VA 20177
Tel: 800-247-9445
www.rehau.com

Republic Windows and Doors
930 West Evergreen Ave.
Chicago, IL 60622
Tel: 800-248-1775
www.republicwindows.com

Torrance Aluminum
22850 Perry St.
Perris, CA 92570
Tel: 909-943-0430
www.torrancealuminum.com

Vancouver Door Company
203 5th St., N.W.
P.O. Box 1418
Puyallup, WA 98371
Tel: 800-999-3667
www.vancouverdoorco.com

Wausau Window and Wall Systems
1415 West Street
Wausau, WI 54401
Tel: 715-845-2161
www.wausauwindows.com

Whisper-Like
P.O. Box 2949
Toledo, OH 43606
Tel: 800-227-8246
whisper-like.com

Windor Supply and Manufacturing
4237 S. 74th E. Ave.
Tulsa, OK 74145
Tel: 800-324-1947
www.windor.com

DUCT AND FAN NOISE CONTROL AND ACOUSTICAL LOUVERS

Acoustical Surfaces, Inc.
123 Columbia Court North, Suite 201
Chaska, MN 55318
Tel: 800-448-0737

Aeroacoustic Corporation
3300 Corporation Way
Darlington, SC 29532
Tel: 843-398-1006
www.aeroacoustic.com

Industrial Acoustics Company
1160 Commerce Avenue
Bronx, NY 10462
Tel: 718-931-8000
www.industrialacoustics.com

McGill Airflow Corporation
One Mission Park
Groveport, OH 43125
Tel: 614-836-9981
www.mcgillairflow.com

DOOR SEALS AND WEATHERSTRIPPING

National Guard Products, Inc.
4985 East Raines Rd.
Memphis, TN 38118
Tel: 800-647-7874
www.ngpinc.com

Pemko Manufacturing Co.
5535 Distribution Drive
Memphis, TN 38141
Tel: 800-824-3018
www.pemko.com

Zero International, Inc.
415 Concord Avenue
Bronx, NY 10455
Tel: 800-635-5335
www.zerointernational.com

ACOUSTICALLY TESTED WINDOWS

Century Manufacturing, Inc.
4620 Andrews St.
North Las Vegas, NV 89031
Tel: 800-654-7027
www.windowtech.com

DeVAC (see Mon-Ray, Inc.)

Graham Architectural Products
1551 Mt. Rose Avenue
York, PA 17403-2909
Tel: 800-755-6274
www.grahamarch.com

Harvey Industries Inc.
1400 Main Steret
Waltham, MA 02154
Tel: 800-942-7839
www.harveyind.com

Industrial Acoustics Company
1160 Commerce Avenue
Bronx, NY 10462
Tel: 718-931-8000
www.industrialacoustics.com

Jeld-wen
19618 Wildwood Drive
West Linn, OR 97068
Tel: 877-783-2057
www.jeld-wen.com

Loewen, Inc.
6465 East Johns Crossing, Suite 400
Duluth, GA 30097
Tel: 800-563-9367
www.loewen.com

Milgard Windows
965 54th Ave. East
Tacoma, WA 98424
Tel: 800-645-4273 (800-MIL-GARD)
www.milgard.com

Mon-Ray, Inc.
801 Boone Avenue North
Minneapolis, N 55427-4432
Tel: 800-544-3646
www.monray.com





ACOUSTICALLY TESTED WINDOWS - *Concluded*

NRG, Inc.
22520 Ecorse Rd.
Taylor, MI 48180
Tel: 312-295-4100

Peerless Products, Inc.
2403 S. Main Street
Fort Scott, KS 66701
Tel: 866-420-4000
www.peerlessproducts.com

Rehau Incorporated
P.O. Box 1706
Leesburg, VA 20177
Tel: 800-247-9445
www.rehau.com

Republic Windows and Doors
930 West Evergreen Ave.
Chicago, IL 60622
Tel: 800-248-1775
www.republicwindows.com

St. Cloud Window, Inc.
P.O. Box 1577
St. Cloud, MN 56302
Tel: 800-383-9311
www.stcloudwindow.com

Therm-o-lite
635 S. Lafayette Blvd.
South Bend, IN 46601
Tel: 574-234-4004
www.therm-o-lite-windows.com

Torrance Aluminum
22850 Perry St.
Perris, CA 92570
Tel: 909-943-0430
www.torrancealuminum.com

Wausau Window and Wall Systems
1415 West Street
Wausau, WI 54401
Tel: 715-845-2161
www.wausauwindows.com

WALL AND CEILING TREATMENTS

National Gypsum Company
2001 Rexford Road
Charlotte, NC 28211
Tel: 704-365-7300
www.nationalgypsum.com

PAC International Inc.
10680 S.W. Industrial Way
Tualatin, OR 97062-9502
Tel: 866-774-2100
www.pac-intl.com

Quiet Solution, Inc.
522 Almanor Ave.
Sunnyvale, CA 94085
Tel: 800-797-8438
www.quietsolution.com

USG
125 South Franklin
Chicago, IL 60606
Tel: 312-606-4000
www.usg.com

## APPENDIX E

## INDEPENDENT CERTIFIED ACOUSTICAL TESTING LABORATORIES





## Appendix E
## Independent Certified Acoustical Testing Laboratories

This list represents a partial list of Certified Acoustical Testing Laboratories that have the capability to perform tests in accordance with ASTM E90. This standard is used to determine the tramission loss and STC ratings of building systems and components. The list below does not imply an endorsement or recommendation by Wyle Laboratories. The National Voluntary Laboratory Accreditation Program (NVLAP) maintains a Directory of Accredited Laboratories on their website:

http://ts.nist.gov/ts/htdocs/210/214/scopes/acots.htm

Acoustic Systems Acoustical
Research Facility
415 East St., Elmo Road
P.O. Box 3610
Austin, TX 78764
Tel: 512-444-1961
www.acousticsystems.com

Architectural Testing Inc.
130 Derry Ct.
York, PA 17402
717-764-7700
www.archtest.com

Intertek Testing Services
3933 US Route 11
Cortland, NY 13045
Tel: 607-758-6215
www.intertek.com

Johns Manville Technical Center
10100 West Ute Ave.
Littleton, CO 80162
Tel: 303-978-3611
www.jm.com/mtc/appliedtechnology

National Gypsum Co.
(NGC) Testing Services
1650 Military Road
Buffalo, NY 14217-1198
Tel: 716-873-9750
www.ngctestingservices.com

Orfield Laboratories, Inc.
2709 E. 25th Street
Minneapolis, MN 55406
Tel: 612-721-2455
www.orfieldlabs.com

Riverbank Acoustical Labs, Inc.
1512 S. Batavia Avenue
Geneva, IL 60134
Tel: 630-232-0104
www.riverbank.alionscience.com

Steelcase Acoustical Test Laboratory
P.O. Box 1967
Mail Stop CD2W06
Grand Rapids, MI 49501
Tel: 616-698-5527

Stork-Twin City Testing, Inc.
662 Cromwell Avenue
St. Paul, MN 55114-1776
Tel: 651-645-3601
www.storkct.com

United States Gypsum Co.
(USG) Research Construction
Systems Laboratory
700 N. Highway 45
Libertyville, IL 60048-1296
Tel: 847-970-5255
www.usg.com

Western Electro-Acoustic Lab., Inc.
25132 Rye Canyon Loop
Santa Clarita, CA 91355
Tel: 661-775-3741

# Appendix F
# Glossary

**Absorption Coefficient** The sound-absorbing ability of a material. Values of absorption coefficient are a function of the frequency of the incident sound. The values of sound absorption coefficients usually range from about 0.01 (for hard smooth surfaces) to about 1.0 (for thick absorptive fiberglass).

**Acoustical Treatment** Applying design principles in architectural acoustics to reduce noise or vibration and to correct acoustical problems.

**Acoustics** The science of sound, including the generation, transmission, and effects of sound waves, both audible and inaudible.

**Airborne Sound** Sound traveling through air rather than through solid materials or the structure of the building.

**Ambient Noise Level** Sometimes called the "background" noise, the level of noise that is all-encompassing within a given environment. It is usually made up of many different sounds, some originating near to and far from the receiver.

**American National Standards Institute (ANSI)** A voluntary federation of organizations concerned with developing standards covering a broad spectrum of topics.

**American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)** A professional organization which identifies and publishes specifications and standard practices relating to all aspects of heating, ventilation, refrigeration, and air conditioning.

**American Society for Testing and Materials (ASTM)** An organization which develops and publishes recommended practices and standards for a broad range of testing and material properties issues.

**Architectural Acoustics** The science of sound, including its production, transmission, control, and effects within buildings.

**Attenuation** The reduction of sound.

**A-Weighted Sound Level** A sound measure, in decibels, that reflects the heightened sensitivity of the human ear to sound frequencies between 1000 and 6000 Hz, and the relatively reduced sensitivity to sound below 1000 Hz or above 6000 Hz. The A-weighted sound level is used to predict the relative "noisiness" or "annoyance" of many common sounds.

**Background Noise** Ambient noise from all sources unrelated to a any particular sound. Background noise may include airborne, structureborne, and instrument noise.

**Balanced Design** A noise control design in which all important noise paths transmit the same amount of acoustic energy into the space, avoiding any "weak links" so that the combined effect ensures an acceptable noise level.

**Building Officials and Code Administrators International (BOCA)** *See International Building Code.*

**Dampen** To cause a reduction, usually through dissipation, of the sound energy.

**Day-Night Average Sound Level (DNL or Ldn)** The day-night average sound level is a measure of the average noise environment over a 24-hour day. It is the 24-hour energy-averaged, A-weighted sound level with a 10 dB penalty applied to the nighttime levels which occur between 10:00 p.m. to 7:00 a.m.

**Decibel (dB)** The term used to describe sound levels.





**Design Criteria** Design goals used in acoustical and noise control design of buildings. Design criteria may be stated either as the maximum allowable noise levels inside buildings or as noise reduction values (from outside to inside) required for certain types of buildings or rooms.

**DNL** See Day-Night Average Sound Level.

**Environmental Noise** Unwanted sound from various outdoor noise sources. Environmental noise sources include aircraft, cars, trucks, buses, railways, industrial plants, construction activities, lawnmowers, etc.

**Frequency** The number of oscillations per second of a vibrating object, measured in Hertz (Hz).

**Hertz** The unit used to designate frequency. Specifically, the number of cycles per second.

**International Building Code (IBC)** A comprehensive building code published by the International Code Council (ICC) covering the fire, life, and structural safety aspects of all buildings and related structures. As of January 2003, the three largest building code organizations in America merged. Building Officials and Code Administrators International (BOCA), Southern Building Code Congress International (SBCCI), and the International Conference of Building Officials (ICBO) integrated to form the International Code Council (ICC). Municipalities may still reference earlier versions of BOCA, UBC, and SBC (as well as IBC). Also, states typically have their own building codes that may incorporate all or part of these codes.

**Loudness** The attribute of a sound, on a scale extending from very soft to very loud. Loudness depends most on the sound pressure or energy of the source, but it also depends upon the frequency and wave form of the source (because the human ear is more sensitive to some frequencies and forms than others).

**Masking** The ability of one sound to block out the perception of another sound. For example, radio static may mask voices in a nearby room. Masking may involve the intentional use of an unobtrusive background noise to cover some other specific intruding sound.

**Noise** Any sound which is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying.

**Noise Contours** Lines or "footprints" of noise level usually drawn around a noise source (such as an airport, industrial plant or highway). The lines are generally drawn in 5-decibel increments so that they resemble elevation contours found in topographic maps.

**Noise Exposure** The cumulative noise reaching the ear of a person over a specified period of time (e.g., a work shift, a day, a working life, or a lifetime).

**Noise Level Reduction (NLR)** The difference between A-weighted sound levels indoors and outdoors.

**Noise Reduction (NR)** The difference, in decibels, of the average sound levels in two adjacent areas or rooms. Noise reduction could be from outside to inside, or from one room to another. Noise reduction combines the effects of the building construction plus the effect of acoustic absorption present in the receiving room. By knowing the noise reduction values and the outdoor noise levels one can determine the Noise Level Reduction (NLR).

**Octave** The interval between two sound frequencies having a ratio of 2. For example, if the center frequency of one octave is 125 Hz, the next octave up will be centered at 250 Hz. and the octave above that will be at 500 Hz.

**Octave Band** A frequency range which is one octave wide. Standard octave bands are designed by their center frequency.

**Octave Band Center Frequency** The average of the upper and lower frequencies of the octave. Standard octave band center frequencies in the audible range are 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000, and 16,000 hertz.

**One-Third Octave Band** A frequency range which is one-third octave wide. Standard one-third octave bands are designed by their center frequency.

**One-Third Octave Band Center Frequency** The average of the upper and lower frequencies of the one-third octave bands. Standard one-third octave band center frequencies in the audible range are:

| | | | | |
|---|---|---|---|---|
| 25.0 | 100 | 400 | 1600 | 6300 |
| 31.5 | 125 | 500 | 2000 | 8000 |
| 40.0 | 160 | 630 | 2500 | 10,000 |
| 50.0 | 200 | 800 | 3150 | 12,500 |
| 63.0 | 250 | 1000 | 4000 | 16,000 |
| 80.0 | 315 | 1250 | 5000 | 20,000 |

**Receiver** The listener who hears a sound or the measuring microphone which detects the sound transmitted by the source.

**Reverberation** The persistence of sound in an enclosed space, as a result of multiple reflections, after the sound source has stopped. The more absorptive the room is, the shorter the reverberation time will be. Generally, if the reverberation time is too short, people feel that the room is "dead" while if it is too long, there is confusion among sounds.

**Shielding** The ability of hills or structures to physically block sound or create shadow zones where sound levels are reduced.

**Sound Absorption** The ability of sound-absorbing materials to trap sound and convert it to heat or some other form of energy.

**Sound Insulation** Reducing the sound level inside a building through the use of specific building construction materials, and component assemblies which provide noise reduction.

**Sound Transmission Class (STC)** A single-number rating derived from measured values of transmission loss, in accordance with ASTM Classification E413, "Determination of Sound Transmission Class". It provides an evaluation of the sound-isolating properties of built construction against sounds of speech, radio, television, etc.

**Sound Transmission Loss (TL)** A measure of a built construction's ability to reduce sound passing through it, expressed in decibels.

**Source** The object which generates the sound.

**Southern Building Code (SBC)** *See International Building Code.*

**Spectral Characteristics/Spectrum** The frequency content of the noise produced by the source.

**Structureborne Sound** Sound energy transmitted through a solid medium such as the building structure.

**Thermal Insulation** A material or assembly of materials used primarily to provide resistance to heat flow.

**TL** See Sound Transmission Loss.

**Uniform Building Code (UBC)** *See International Building Code.*





## APPENDIX G

## DESIGN PRESSURE REQUIREMENTS

# Appendix G
# Design Pressure Requirements

Chapter 44 of the North Carolina Building Code includes requirements for High Wind Zones. These requirements have a significant impact on the sound insulation process, since they affect which window and door products can be used in the area. Table 4402(a) of the Code lists the required design pressures in pounds per-square-foot (psf) for windows and doors (not including garage doors), as a function of two parameters: the wind velocity (mph) in the area, and the mean roof height (feet). Many locations near MCAS Cherry Point and MCALF Bogue Field are within the highest velocity zone of 130 mph. The highest design pressure required in this velocity zone is 47 psf; this applies when the mean roof height is 35 feet. Reduced design pressures are allowable when the roof slope is 10 degrees or less, or when the window or door is more than four feet from a corner.

Many of the manufacturers listed in Appendix D cannot provide products that achieve both a high STC rating and a high design pressure. Below is a discussion of some products that can meet both the STC and design pressure requirements. There are likely many more options – this discussion is not all-inclusive. Note that the design pressure a window can achieve varies significantly based on the operational type; fixed windows are the best, casements are in the middle, and hung and sliding windows are the worst.

WINDOWS

For windows one solution is to use hurricane shutters than can meet the design pressure requirement over acoustical windows that can meet the STC requirement.

Another option is to use an acoustical aluminum dual window. These windows can achieve design pressures of 50 to 90 psf; three manufacturers of this product are St. Cloud, DeVAC, and Graham.

One acoustical combination window (aluminum storm with vinyl prime) that can meet the design pressure requirement is manufactured by Harvey Industries, Inc. Some of the Harvey vinyl windows that do not have storm panels may also be able to meet the design pressure requirement.

DOORS

There are many storm doors that can meet the design pressure requirements. These include PGT Industries, Inc. , Armaclad, and Whisper-Like. These storm doors should be used in combination with a prime door that has a high STC rating.

There is at least one prime door that can meet a design pressure of 50 psf without the use of a storm door: Armaclad.

# Section 13.8 - Joint Land Use Team Implementation Charter

## Mission Statement

- To promote compatible development while maintaining the current and future missions of the Joint Base
- To collaborate on land use planning and development
- To enlighten the public on joint base mission changes
- To facilitate discussion, debate, and dialogue concerning these issues in a friendly and open atmosphere

## Guiding Precepts

- Joint Land Use Study is baseline
- Open communications
- Sound land use principles
- Community safety and well being are paramount
- Semi-annual Joint Land Use Team meetings
- Joint base participation in municipal planning board meetings

## Scope

Includes the ten neighboring communities which participated in the Joint Land Use Study and Joint Base McGuire-Dix-Lakehurst

## Organization

Municipal leadership, joint base leadership, county, regional and joint base planning professionals

## Oversight

One representative from each County and the Joint Base will have oversight responsibilities to ensure the intent and spirit of the Joint Land Use Study is complied with, that meetings are scheduled and that necessary logistics are addressed.

## Committee Signature Page

_____
Mayor, Jackson Township

_____
Mayor, Lakehurst Borough

_____
Mayor, Manchester Township

_____
Mayor, New Hanover Township

_____
Mayor, North Hanover Township

_____
Mayor, Pemberton Borough

_____
Mayor, Pemberton Township

_____
Mayor, Plumsted Township

_____
Mayor, Springfield Township

_____
Mayor, Wrightstown Borough

_____
Freeholder, Ocean County

_____
Freeholder, Burlington County

_____
Commander
Joint Base McGuire Dix Lakehurst

_____
Installation Commander, Fort Dix

_____
Installation Commander,
McGuire AFB

_____
Commanding Officer,
Naval Air Engineering Station

_____
Director, Ocean County
Planning Department

_____
Director, Burlington County
Office of Economic Development
and Regional Planning

_____
Commissioner, Pinelands Commission

**Joint Land Use Study Public Meeting**
Primary School Multi-Purpose Room
131 Evergreeen Road, Plumsted NJ
March 30, 2009
6:30pm – 8:30pm

At 6:30pm David McKeon, Ocean County Planning Department Planning Director, began the meeting by thanking Mayor Ron Dancer for hosting the Public Meeting. He also informed the public that there would be plenty of time after the presentation for comments. David McKeon asked all members of the public present to sign-in if they had not done so already. David McKeon then introduced Brandi Bartolomeo from Paulus, Sokolowski & Sartor (PS&S) and Bret Gordon from Sabre Systems.

Brandi Bartolomeo thanked the members of the public for attending and informed the crowd that PS&S had done the land use and noise analysis, Sabre Systems the military analysis, and HR&A the economic analysis for the study. The County of Ocean and the Department of Defense Office of Economic Adjustment sponsored the study. Ocean County Planning Department, Burlington County Department of Economic Development and Regional Planning, the Department of Defense Office of Economic Adjustment, and the consulting team collaborated during the study. Brandi informed the public that core Joint Land Use Study team members and the consultant staff would be available to field comments and answer questions after the meeting for those public members not comfortable with speaking in a crowd.

Brandi described the agenda for the night; quick summary of the Joint Land Use Study Report one section at a time, discussion of suggested recommendations, followed by question and answer session. She proceeded with introducing the definition of a JLUS.

JLUS is an acronym standing for Joint Land Use Study. There are three military installations around the area, Lakehurst Naval Engineering Station, Fort Dix Post, and McGuire Air Force Base. These installations were formed in the early twentieth century, when the communities weren't as developed as they are now. The military missions grew at the same time the surrounding municipalities' land use expanded creating impacts for both the military and the surrounding municipalities. In 1985, the Department of Defense created the Joint Land Use Study program (JLUS) to encourage cooperative growth with the communities and seek ways to reduce impacts created by the communities that affect the military and impacts created by the military that affect the community.

Each Joint Land Use Study has their own objectives. In this Joint Land Use Study, the objectives were broken up into community objectives and military objectives. The community objectives were to protect the health, safety and welfare of the residents, maintain quality of life for everybody in the community, guide growth away from the air strips and high noise areas, and maintain economic vitality and sustainable growth. The military objectives are to protect the health, safety, and welfare of the military personnel, preserve the Joint Base missions so that they can protect the country and continue to grow. A framework for communication will be created for both the military and communities and this study is initiating the process. Brandi introduced Bret Gordon.

Bret Gordon asked the crowd to identify which county they are from. There was a good showing from both counties, however the majority of public members reside in Burlington County municipalities. Bret Gordon gave a summary of plans for the Joint Base.

The Joint Base is a large area in central New Jersey that impacts two counties, ten municipalities, and three military installations. This study focused predominantly on the three military installations, the surrounding area, and the two-mile perimeter around the installations.

In 1995 the military installations were informed that there was a possibility of being selected for base closure. The three adjacent military installations started communicating with each other to find solutions for preserving their installations and missions. They figured that there was strength in numbers and pushed the idea of becoming a large consolidated base. Former Congressman Jim Saxton, was a large advocate of the "mega-base" known today as the Joint Base, especially during the Base Realignment and Closure process.

In 2005 the McGuire, Fort Dix, and Lakehurst installations were selected to become a joint base. Twelve Joint bases were created throughout the United States. Typically Joint Bases consist of two services with consolidated installation management services. Joint base McGuire, Dix, Lakehurst was identified as the only tri-service Joint Base in the United States. The three services will consolidate installation management services, thereby reducing the cost of operation.

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The combining of the three installations has raised complexities and issues not seen in other Joint Bases. When the Joint Base stands as one there will be concern about losing the rich heritage of each individual installation from the military personnel and surrounding communities. This is not the intent of the joining of the three installations. One of the challenges for the new commander of the Joint Base, Col. Grasso, will be to ensure that the three military installations operate as one and continue to maintain each of their own identities.

Lakehurst NAES has been around since around 1917. It started off as a Russian proving ground that eventually morphed into a US Army proving ground and then into a Naval Air Station. The Naval Air Station then became the Naval Engineering Center and finally morphed into the current configuration of Lakehurst Naval Air Engineering Station (NAES). Lakehurst NAES has many missions, however their predominant mission is supporting aircraft carriers with catapults and arresting gear. This mission is extremely important because the aircraft carriers are ineffective without this gear and Lakehurst NAES is one of the few installations with the technological knowledge to do this type of mission in the world. Lakehurst NAES is adjacent to and directly impacts the municipalities of Jackson, Manchester, and Lakehurst.

Fort Dix Post has been around almost as long as Lakehurst NAES. Fort Dix has had a long rich history and has morphed into a reserve mobilization base. Soldiers are sent to Fort Dix when they are activated for training before being sent abroad for their missions. Fort Dix covers about 40,000 acres of the entire Joint Base. They have the most land and therefore impact six of the ten municipalities participating in the Joint Land Use Study. The adjacent and directly impacted municipalities are Manchester, Jackson, and Plumsted Townships in Ocean County and Pemberton, Springfield, and New Hanover Townships in Burlington County.

McGuire Air Force Base's predominant mission is the transport of materials and personnel all over the world. There are three municipalities directly impacted by the McGuire Air Force Base. These municipalities are Wrightstown, North Hanover, and New Hanover.

All three installations independently provide an important link to the battle against terrorism. Fort Dix provides the soldiers, McGuire Air Force Base transports the soldiers and materials, and Navy Lakehurst helps train the Army and Air Force personnel and provides technological support for the aircraft carriers. The significance of this Joint Land Use Study is to maintain these missions while meeting the needs of the community as well.

Brandi Bartolomeo summarized the year long Joint Land Use Study process. The process included 8 policy committee meetings, 6 consultant meetings, technical committee meetings, and 10 municipality meetings. The Municipal meetings were an opportunity for each separate municipality to present an overview of their concerns, relationship with the adjacent military installations, and municipal planning board's goals and objectives. Numerous military meetings with commanding officers and their staff took place as well. Public outreach was done in September through two public open houses, one in Ocean County and the other in Burlington County.

In September of 2008 two Open Houses were hosted for the public to inform them about the Joint Land Use Study and offer them an opportunity to have input regarding concerns they have about the Joint Base and their municipality. The "Base Next Door" video was presented at the open houses, the video gave a history of the Joint Land Use Study program. Individual municipal displays and military displays were also presented. The individual municipal displays presented land use, zoning, preserved lands, proximity to the Joint Base, and environmental constraints for each municipality. Each military installation was represented by military personnel to answer public questions and concerns.

Other medias for public outreach included the online surveys, interactive mapper, and Joint Land Use Study public website. The online surveys were available at computer stations at the open houses and kept on the Joint Land Use Study website for six months. There were fifty responses from the public, lower than what had been expected. A Joint Land Use Interactive Mapper was also created and posted onto the JLUS website, which allows respondents to enter their address and shows them their location relative to the Joint Base. The mapper is still available on the JLUS website. The website also has posted presentation meetings from policy and technical meetings, PowerPoint presentations, JLUS in the news, "Doing Business with the Military" a contracting workshop summary and contact information, and the Draft JLUS report.

The Draft Joint Land Use Report is divided into sections. The executive summary is the "cliff-notes" of the report. Other sections discuss the background of the study, the need for the study, the study area defined, the base mission and projected missions (which was just summarized by Bret Gordon), community analysis, state planning considerations such as the Pinelands and state plans, infrastructure capacity for the nearby municipalities, economic

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considerations, and existing land protection strategies, and recommendations. Brandi recommended reading the executive summary and recommendations section for a thorough summary of the study.

Brandi introduced Mark Hoffman, Noise Analyst from Paulus, Sokolowski, and Sartor, to define noise and summarize how it pertains to the Joint Land Use Study. Noise and Sound are interchangeable. Noise is essentially unwanted sound. Noise is an issue of perception such as our attitude towards the source of the sound, physical ability to hear, past experiences, and the components of sound (tonality and loudness). Sound is measured with the decimal scale. Calibration for sound levels: noisy urban daytime is about 80 decibels, quiet urban daytime is about 50 decibels, suburban quiet night time is about 40 decibels. Speech is the best gage of sound. Speech at about 3 to 5 feet from source is about 60 to 65 decibels. When background sound levels approach 65 decibels or greater overcompensation occurs by raising the voice in order to be heard.

The JLUS analysis was based on previous studies such as AICUZ, IMNP, etc. These previous studies essentially did modeling of sound level outputs. Two of the studies were associated with aircrafts from McGuire and Lakehurst. One of the studies was from Fort Dix, which showed the small arms and artilleries sound outputs. The distribution of sound was analyzed and points of equal sound were connected into contours. These contours are not physical lines and can change depending on environmental conditions. The models are conservative and show maximum noise levels, however new models have not been done recently for the entire Joint Base. The perceived sound can be lower or higher than what is modeled.

The Federal guidelines create noise zones for land use planning purposes. Mark presented maps depicting the noise zones around the Joint Base. The A-rated scale is the most relative to human hearing and is weighted on center frequency of sounds of the octave bands. C-wave rating accounts for the lower frequencies, which may create vibrations due to sound. The peak sounds are associated with intense sounds such as small arms.

The range of sounds were divided into three noise zones. Noise zone one represents 55 decibels to 65 decibels and generally allows development of sensitive land uses. Noise zone two represents 65-75 decibels and generally does not allow incompatible land uses such as sensitive land uses. Noise zone three represents 75 decibels or greater and does not allow incompatible land uses such as sensitive land uses. Sensitive land uses are residential, hotels, hospitals, schools, and other high-density uses. The Land Use Planning Zone (LUPZ) is a zone that takes into account the expansion of the noise zones, which on some days can expand further into the community based on conditions and other variables.

Mark described the Accident Potential Zones, which takes into account aircraft safety. The Accident Potential Zones are the Clear Zone, Accident Potential Zone 1 (APZ 1) and Accident Potential Zone 2 (APZ 2). The clear zone is a zone that extends 3000 ft from the ends of the runways and 3000ft wide. It is based on the statistical potential for an accident, based on data gathered from previous military accidents throughout history. The percentage of accidents that have occurred in the clear zone is twenty-seven percent. Development is discouraged in the clear zones. Accident Potential Zone 1 extends another 5,000 ft beyond the clear zone and is also 3,000 ft. wide. About ten percent of accidents occur in APZ 1. High-density development such as high-density residential, commercial, and public uses are discouraged in APZ 1. Accident Potential Zone 2 extends 7000 ft beyond APZ 1 and is also 3,000 ft. wide. About five percent of accidents occur in this zone.

In general the noise zones and Accident Potential Zones should be used as guidelines to restrict development and encourage it elsewhere. Brandi informed the attendees that if they wanted more information regarding the noise zones and APZ's that they should read section six of the report, which goes into further detail.

The community was analyzed in section seven. The community analysis took into account vacant lands, existing zoning, municipal ordinances, and environmental constraints to construct a built out analysis for each municipality. Only the two-mile buffer area of the municipalities was analyzed. All preserved land, such as farmland and natural lands, were extracted out to calculate residential density. The total vacant land was accounted by using tax records. Farmland was viewed as an active use, and was looked at for a possibility of development. North Hanover Township and Pemberton Township had the most possibility of non-preserved farmland being developed in the future. The recommendation is to keep the existing farmland surrounding the Joint Base in its current use.

Economic considerations were analyzed in section ten. The evolving Joint Base mission and the surrounding demographics were taken into account. The joint base is both a negative and positive factor for the local economy. The three military bases are the largest employers for the two counties. A summary of the civilian population wage rates and residential information was presented. Lakehurst NAES has a high median income because of all the research and engineering high wage jobs. Fort Dix Post has over 70 percent of their civilian workers living in Burlington County municipalities.



Willow Grove base will be sending their missions and personnel to the Joint Base by 2011. There will be 625 active duty military personnel with a projection of 331 spouses and 682 total family members arriving at the Joint Base. There will be an increase of school children, commuters, and in the tax base because some of these new families will become homeowners.

Major growth sectors such as manufacturing, retail, health, and education were also analyzed in the economic section. Burlington County has a high manufacturing sector and should consider partnering up with the joint base. Both Ocean County and Burlington County have a large senior citizen population who will need health care in the future, therefore this sector will continue to grow. Retail growth will occur both from the demand of the large senior citizen population and new personnel moving to the Joint Base. Both counties should focus on education. The joint base has stable high paying jobs with an older civilian workforce that will be retiring and will need to be replaced. Ocean County College and Burlington Community College should partner with the Joint Base to create curriculums that will prepare the younger population for future joint base vacancies. Sites were chosen within the two-mile buffer for possible economic development.

Suggested Implementation issues were identified: lack of communicational procedures between the Joint Base and the surrounding municipalities, collaboration between the communities and the joint base, lack of public awareness of the joint base, implementation procedures and support system after the study has been completed, decrease urban growth around the joint base, restrict height of development, mitigate noise complaints from the community and develop programs for retrofitting of existing structures, reduce development in Accident Potential Zones, availability of affordable housing, commercial competition between the base and communities, and real estate disclosure mechanisms for the 2-mile area.

The JLUS report is intended to be a dynamic document that will guide the implementation phase. A charter will be created to ensure that the community and Joint Base agree to keep working together during the implementation process. Other communication solutions are to create an operational manual for base commanders and local politicians, designate a Joint Base planner to attend municipal planning board meetings, create a Joint land Use study website for the military and communities to communicate with the residents about missions, events and local issues. Land use solutions are to add the Joint Base into municipal master plans, rezone areas of non-compatible uses in high noise zones and Accident Potential Zones, and completion of an AICUZ for the whole entire Joint Base that takes into account the new missions. Other land use solutions were to create a Municipal Transfer Development Rights program as a tool to steer development away from high noise areas and Accident Potential Zones and continue to preserve agriculture and open space around the Joint Base, which is compatible development. Another solution is suggesting to COAH that they remove areas located in high noise areas and Accident Potential Zones as developable lands, which would reduce the amount of affordable housing obligations for the municipalities and protect low/moderate income clientele from buying those units.

The floor was opened to the public for the Question and Answer session:

Q: Is their going to be a Warren Grove Joint Land Use Study and is it associated with this Joint Land Use Study?
A: Yes there is going to be a Joint Land Use Study for Warren Grove, and it is a separate study from this one. Burlington County is working to get it underway.

Q: The Analysis includes build out of existing buildings and Master Plans should include the Joint Land Use Study?
A: The municipal Master plans should acknowledge the Joint Base, their missions, noise zones and accident potential zones. The study is a recommendation to the municipalities.

Q: What happens if the municipality is proposing a Master Plan that is changing the zoning to increase density within the two-mile area and is lacking in addressing the Joint Base?
A: The Study is not saying that all development within the two-mile buffer is a bad thing, but for municipal planners to add the noise zones and accident potential zones in the master plans and develop away from those areas. Municipal planners should make residents in the 2-mile area around the base aware of the Joint Base, but not necessarily prevent them from developing if they're not in a high noise or accident potential area. The study wants to prevent unilateral decisions from being made by the military or the municipalities. A unilateral decision without considering the impact on the military or the surrounding municipalities can have adverse affects. It would be better to have all parties involved get together to weight the pros and cons and make a decision that takes into account the military missions and the community needs. The Joint Land Use Study Report should act as a catalyst for open communication between the entities.

Q: In 1950 a jet did crash within the 2-mile buffer area. It's very important for people to take this into consideration.
A: That is why it is important to take the military into account in land use decisions and provide real estate disclosure for those new residents moving into the area. Real estate disclosures aren't supposed to be a negative on property value but an awareness of the Joint Base next door. The military safety record has increased since that time. However, it is important to provide low-density areas for emergency landings that could be caused from natural incidents (bird strike).

Q: Is their going to be an area for comments and questions on the website for those who have not had the chance to read the Joint Land Use Study report from the website?
A: Yes, Brandi's email address will be provided for comments and questions for a two-week window. Brandi will answer questions sent to her.

Q: Were the rural areas in the Pinelands considered for Transfer of Development Rights, because only areas outside of the Pinelands were mentioned?
A: Yes, the Pinelands have a TDR program that will be used and the development of a TDR program for those areas lying outside of the Pinelands region has also been recommended. The rural areas in the pinelands can also be considered for TDR by municipalities. More information is provided in section eight of the report.

Q: What specific planes are coming from Willow Grove? We're used to having transports operating from specific runways. Old KC-135's are still flying and they are very noisy. Were actual studies done pertaining to these airplanes or where generic airplane noise levels used?
A: Actual studies were done of the aircraft at the installations. The noise data is from AICUZ and ICUZ done at McGuire and Lakehurst NAES. An AICUZ study will be done around 2010 or 2011 that will incorporate the new aircraft arriving at the Joint Base as well as the existing missions for the entire Joint Base. Helicopters are the majority of aircraft arriving from Willow Grove

Q: Does anybody have a decibel limit on military helicopters?
A: That data has not been gathered in this report. It was mentioned in the study and recommended that they be taken into account. The types of aircraft that will be coming to the base is mentioned in the noise section, section six.

Q: Are fighter planes coming? War hogs?
A: No War Hogs, but A-10's will be coming from the National Reserves.

Q: So there are three types of aircrafts that will be operating at the Joint Base. They all operate under separate conditions. Helicopters have separate approaches and departures from the base. They usually fly outside of the clear zones and APZ zones of other aircrafts, usually to the side. The fighters and transports are so different that they have to fly different patterns. Pemberton Twp. has designated an area within the 2-mile buffer for high-density development. You've mentioned that you would like to slow down the growth and that's a good idea. However, the administration of the township has turned their back on all recommendations. Willow Grove is a very noisy operation and until there is certainty about the actual missions and how they will operate at the Joint Base, the township should hold off on developing.
A: Pemberton Township just came out with a new Master Plan. They have asked for input from the JLUS consultant team. They have incorporated the noise contours and Accident Potential Zones, as recommended. The section they want to develop falls well outside of the noise contours and Accident Potential Zones currently mapped. We are concerned about the Brown's Mill area for future infill development. The McGuire just redid their AICUZ and their noise footprint is smaller than it used to be but still effects the Brown's Mill area.

Q: The area is north of the safe zone, but still within the 2-mile buffer.
A: An area can still be developed within the 2-mile buffer, as long as it doesn't lie in the noise zone or APZ zones.

Q: The last time they did an AICUZ was in September 1999. In 2011 they're going to do another AICUZ study with the Army Black-Hacks from Trenton and other aircraft from Willow Grove. However the Helicopters are extremely loud. They won't plug the runways, but they're very slow and noisy. What is going to be their flight path?
A: McGuire just completed an AICUZ in 2008. All aircraft will be taken into account in the 2011 first Joint Base AICUZ study. The National Guard helicopters relocating to Lakehurst are oversees until 2011. The flight paths will probably be east of McGuire and west of Lakehurst.

Q: Where is the area of North of Pemberton? Give some boundaries.

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A: Brandi presented a map of the Joint Base area and pointed to the region. The area was outside of the Joint land use planning zone created for the Joint Base noise contours and APZ's. The land use planning zone only shows the current situation and does not project the incoming aircrafts and missions. There could be more or less noise in the future outside of the Land Use Planning Zone (LUPZ).

Q: Is Wrightstown Borough going to be developed with new businesses?
A: Wrightstown is going to be redeveloped. A four star hotel, Lady of Our Lords hospital clinic and Burlington Community County College classrooms and office space is underway and is part of phase one. In the next 60 days, an announcement for phase two will be announced, which will house most of the retail on Saylor's Pond Road. Wrightstown will not survive just with the military support, but also needs the community to support it.

Q: Some planes in the flight path screech over my house and the mortars from Fort Dix shake the house. Will the increase in traffic cause more problems?
A: Most of the new planes coming to McGuire will be transport aircraft, which are quieter. They are also new models with the latest technology. Fort Dix starts their missions at 6:00am and ends by 11:00pm. The website will have contact numbers for noise complaints if they get worse.

Q: James Durr, North Hanover Mayor, stated that a full-circle of land has been preserved as farmland. The demographics from the surrounding community will not support commercial districts without the military demographics supporting it as well. Continuing retail use behind the military gates has been rumored. Should we be investing tens of thousands of dollars into a commercial area that the military might not use? Should the municipality look at other means of supporting the local economy? There is a 60% vacancy for retail. We need the military to have direct communication with us to ensure that we are on the right track and that they support the municipal initiatives.
A: The JLUS report recommends that the military designate a Joint Land Use military planner, who would be able to be approached for such issues. Sites in North Hanover have been suggested for development in the Economic section.

Q: Mary Anne Reinhart, Burlington County Freeholder, asked about the number of planes coming to the joint base and the percentage of increase for the missions.
A: Yes, that information can be found in section 5 of the JLUS report. About 25 new aircrafts will be relocated to the Joint Base.

Q: Which municipality will have the most increase in school age children?
A: The new children coming to the Joint Base and their school designation have been mentioned in the study as a situation to monitor. However it is outside the scope of the study. The last Commander of McGuire had wanted to combine all the school children into one school system. However that is a litigation situation and more of a state level situation. There is a new commander, Col. Grasso, and that is something that should be further discussed with her.

Q: What is the time line?
A: For the built out analysis there was no time line but represents the natural progression over time if zoning and regulations remained constant.

Q: Do the local municipalities receive a hosting fee and would the federal government consider it now that the missions are expanding?
A: The municipalities do not receive any funds now, but that is something that could be brought up to Col. Grasso.

Q: Is the military willing to reveal how many bird strikes they get on the Joint Land Use website? The federal government has requested that airlines give out those bird strike numbers.
A: Lakehurst NAES has not had a bird strike in years. Bird strikes are not a huge problem for the area, but it was put into the report for everybody to be aware of the potential problem and to mitigate it before it becomes a problem.

Q: Has a study been done to show the overflow onto adjacent municipalities of the ten participating municipalities?
A: The Joint Land Use Study is a moment in time. The counties and ten municipalities chose to be a part of this study. In the future, if these surrounding areas need to be brought in they will.

Q: How are the additional aircraft going to be covered in regards to fire or catastrophe?
A: The fire protection mechanisms are in place and they cover more than one aircraft. The addition of these planes will not cause any additional hardships. The posture will not change because safety is paramount. Brandi suggested acknowledging the problem and offering solutions if a fire gets out of hand on the base and how to handle it.

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Q: Will Lakehurst receive more aircraft and traffic?
A: Lakehurst will not receive more aircraft assignments. However an Assault Landing Zone has been built for training of C-17's stationed on McGuire. This training has increased the traffic flow into Lakehurst. Dover Air Force Base also does training flights at Lakehurst. The traffic will increase about ten fold from the level currently there now.

Q: Why do some planes screech overhead and others are so quiet?
A: Some of the aircraft are older and will be replaced by the new models. That will decrease the amount of noise you hear from the screeching aircraft.

Q: What is the projection of the dollar amount coming in from the base?
A: Rutgers did a study about ten years ago that showed significant dollar amounts flowing from the military installations into the community. Those figures have not been updated but those figures can be used if inflation is taken into consideration.

Q: Will the dollar amounts be self-contained on the base or will it flow out into the community through housing and retail?
A: If industry is attracted then it will flow out. Housing doesn't attract jobs other than when they're built through construction. Industry and education attract jobs. Partnership with local community colleges, Georgian Court, and other State Colleges and Universities, to build satellite campuses will attract other industries that want to be around educational facilities that they can draw from.

Q: Is that a community model or military model?
A: It's a community model, but the base is the catalyst in some regard. Lakehurst hires engineers and logisticians. They are government workers and over time government gets an aging workforce. This aging workforce needs to be replaced. It's the community colleges and local colleges that will develop the curriculum to educate the next wave of government workers. As the base mission grows they will need more contractors. Currently the government workforce has a large baby boomer population that will need to be replaced within the next ten to fifteen years. Now would be the time to get the local younger population educated to ensure the jobs stay local.

Q: Was the Increase of traffic flow because of the road closures through Fort Dix mentioned?
A: Yes, the increase in traffic flow, road closures, as well as vehicle weight impacts is mentioned in the report. Range Road and other road closures took place because of 911 and the pizza delivery terrorism plot.

Q: Was an alternate route looked at for those who now have to go the long way around?
A: A more in depth traffic study for the Joint Base area was recommended. There is a possibility that DOD could fund this study.

Q: When is the final report going to be done?
A: Public comments are going to be considered and then a final report will be done by the end of April.

Q: What is the timeline for implementation?
A: In the recommendations section each recommendation has a timeline for implementation when it should be completed. Range is months to 5 years depending on the importance of the recommendation.

Q: In regards to the industry, are their examples where the military has lead the industry such as the creation of satellite campus you are speaking of?
A: In the economic section in the report there are examples where these industries have thrived with the assistance of the military.

Q: What kind of industry would be good for this area?
A: Manufacturing because of the proximity to Philadelphia. The Joint Base could act as a catalyst by attracting consultants that might need those manufacturing goods. Also the new military personnel would attract retail.

Q: Would this development look more like Princeton?
A: It depends on the mission of the base. There is research and development that takes place on Lakehurst NAES, however none on McGuire or Fort Dix. Lakehurst contracts annually $789 million dollars for research and manufacturing. It is a tremendous opportunity, if the community wants to respond. A reduction in force in military personnel during peacetimes will be supplemented with consultants because the missions do not change. Open communication will allow for opportunities for the local community to fill in the gaps where there is less military.



Elected officials are working to create economic opportunities using the Joint Base as a driving force. Tenants such as Homeland Security can be stationed at the Joint Base, which would hire many workers in an office style setting.

Q: These tenant facilities do attract jobs, but what about housing retail and facilities off-base so the municipalities can reap some benefits?
A: Open communication is the best solution, so that when the Joint Base has to make a decision they can make an informed decision with all viewpoints rather than just with their own personnel need.

Q: The military installations are considered federal land and businesses do not have to pay local taxes, so the communities do not reap the benefit of ratables.
A: A future study that might come out of this study is an economic study that further analysis the impacts the military installation is having on the local economies. Several municipalities on the Burlington County side have mentioned this as a problem for their municipalities.

David McKeon stated that the Joint Land Use Study is looking at encroachments specifically at this point but further studies and opportunities will be looked at. The report is on the web. The many issues brought forth by the study will be ongoing. The report is not a final conclusion but will continue. The Policy Committee and Technical Committees will continue to meet to resolve the issues brought forth. Congressmen Smith, Saxton, and Adler's offices have been actively participating in the Joint land Use process. US Senator Mendezes office sent a representative tonight.

A final question was asked regarding the length of time the public had to comment on the report. Brandi Bartolomeo gave a two-week window (March 30 to April 12, 2009) for public comments. Comments should be sent to her email address found on the Joint Land Use Study website and will be taken into account.

David McKeon thanked the audience for coming out.

Meeting was adjourned at 8:30pm.

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# Joint Base McGuire-Dix-Lakehurst
# Joint Land Use Study for Counties of Ocean and Burlington

**Final Report: April 2009**

**Sponsored by the Department of Defense, Office of Economic Adjustment and the County of Ocean**

*PS&S ~ Sabre Systems, Inc. ~ HR&A Advisors*