WHAT IF NEW YORK CITY
DESIGNING POST-DISASTER HOUSING FOR URBAN AREAS
DESIGN COMPETITION and URBAN DESIGN CASE STUDY
After the storm much of the waterfront has been washed away and many homes have been lost. Interim housing is carefully deployed, sitting lightly on the ground.

On the day before the hurricane, Prospect Shore is a thriving, historic waterfront neighborhood.
Keeping people close to home has allowed the neighborhood to come back, retaining its character while adapting and becoming more resilient to future storms.
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What is Urban Interim Housing?

Introduction

New Yorkers love their neighborhoods second only to their families. Our neighborhoods depend on durable infrastructure, great design, and most importantly a concentration and diversity of people. Before New York City can rebuild itself after a disaster, it will have to rebuild its neighborhoods.

In the wake of a disaster, waves of after-shocks strain cities. The worst among them is the out-migration of people wanting to rebuild their families, homes and jobs away from the destruction. If enough people leave, some estimate about 30% the city is unlikely to ever regain its pre-event vitality. We will need every New Yorker to be a part of the rebuilding process.

Housing is already in critical short supply in New York City, but after a large catastrophe the demand for safe affordable housing will far outweigh supply. We will need to find a way to fill this gap.

Housing is critical, but the solution will have to do more than just provide housing units. It will have to encompass replacement of the complex social and economic networks that make life in New York what it is. Our functioning neighborhoods provide a place to live, work, learn, play, raise children, make friends, and relax.

This document offers a case study example of the development of post disaster interim neighborhoods for New York City.

We use a fictitious but realistic neighborhood called “Prospect Shore” as the context for our hypothetical case study. We imagine a Category 3 Hurricane has destroyed a much of the housing and infrastructure of Prospect Shore. We also imagine that the City has resolved to aid in the reconstruction of this neighborhood by providing a place for residents to live during the reconstruction.

Project Background

In 2007, with sponsorship from the Rockefeller Foundation, NYC Office of Emergency Management (OEM) hosted a design competition for deployable housing after a major hurricane. The design brief and all entries are posted at: (www.whatifnyc.net). This competition first introduced Prospect Shore and the hypothetical hurricane to hundreds of design teams from around the world.

Using the best competition entries as a basis for the Interim Housing Units (IHUs), OEM and partner agencies including the DDC issued a request for interest to the housing industry to identify a logistics supply chain to build, deliver and install a high volume of NYC IHUs immediately.

To leverage the full capacity of the entire manufactured housing industry, OEM and DDC created a performance specification that is a robust solution for big cities: a universal Interim Housing Performance Specification (IHPS).

The IHPS contains stringent requirements for safety, environmental quality, durability and universal design but is flexible enough that virtually any factory can quickly retool to supply them.

To reflect the best thinking on all aspects of the IHPS, many City and Federal agencies provided expertise, including NYC’s Dept. of Buildings (DOB), NYC’s Fire Dept. (FDNY), ConEd, Dept. of Environmental Protection (DEP), Dept. of Transportation (DOT), Dept. of Health & Mental Hygiene (DOHMH), HUD, FEMA, USACE and more.
**Why interim housing?**

After the immediate danger of a weather event like a Hurricane is over, some people may not be able to return home right away – their houses may be damaged, or even destroyed, and it may not be possible for them to stay with a relative or friend for an extended period of time, while their home is re-built. Interim housing is temporary, providing a place for people to get on with their lives, while the fabric of their communities is mended. That said, stays in interim housing may last a few weeks to a few years, and such housing will need to provide a high level of comfort and a variety of neighborhood services beyond what might be found in emergency shelters.

During and immediately after an emergency, the City has a plan to provide shelter for people who are evacuated. Those shelters will be located in public buildings and will not be suitable for staying for longer than a few days. Interim housing is for that period in between the immediate aftermath and the finished reconstruction of buildings. It can be from 5 days after the storm to as long as five years, depending on the rate of re-construction of a particular home. Under the FEMA Individuals and Households Program (IHP) Temporary Housing component, interim housing is provided during the intermediate period (generally up to 18 months or the maximum amount of financial assistance available by law) between emergency sheltering and the securing of a permanent housing solution.

**Forms of Interim Housing**

There are a variety of options for interim housing after a natural disaster. The top priority in New York, will be to identify vacant, undamaged properties, particularly rentals, where individuals can be housed. The following are interim housing options, in order of priority:

1. Utilize available rental vacancies
2. Utilize available non-rental residential
3. Rapidly repair residential properties with minimal damage
4. Adaptive use of non-residential buildings
5. Deploy interim housing units

Our case study focuses on this final option. In the event of a catastrophe such as a category 3 or 4 hurricane the housing demand will almost certainly exceed the available housing options within the city, and people will need to be housed in temporary structures. While some people may leave the city, stay with friends or family, or find some other option, our case plans for people staying close to home, at least in their own neighborhoods.

In the United States, temporary housing constructed after natural disasters has usually been done in areas with large open spaces – resulting in a suburban type of housing. Most homes are trailers or manufactured single-family homes sited individually or within a trailer-park-like context with each unit freestanding. Traditional federal assistance is focused on providing the individual housing and is geared toward homeowners.

As a dense city with little available land for development, only one existing commercial trailer site, and a high percentage of the population being renters rather than homeowners, the traditional approach to post-disaster modular housing would be difficult to deploy in New York City.
The Goal

Interim Housing should help to heal the city’s neighborhoods.

It should be safe, comfortable, and temporary.

The mechanism for insuring that interim does not become permanent housing should be through policy. Poor design should not be used as prod to convince people to find permanent housing elsewhere.

Quickly move displaced residents out of temporary shelters:
- Keep people close to home
- Coordinate with citywide recovery plans.
- Integrate housing into the community
- Provide a safe and comfortable environment
- Provide housing that reflects New York’s unique character
- Sit lightly on the site
- Provide access to services beyond housing
- Coordinate with citywide recovery plans.
- Provide transportation linkages, including connections to the surrounding community and key destinations
- Keep people close to home
Interim Housing Development Process

**PLANNING**

- **User**: Home
- **Government**: Planning
- **Designer**: Shelter
- **Builder**: Unit Design

**PHASE 0**
- Pre-Disaster Design & Permitting

**PHASE 1**
- Site Selection and Preliminary Design
  - 2 - 3 weeks

**PHASE 2**
- Environmental, Land Use, and Public Review
  - 2 - 4 weeks

**PHASE 3**
- Final Design and Permitting
  - 3 - 6 weeks

**PHASE 4**
- Construction
  - 4 - 8 weeks

**RESPONSE**

- **Contractor Agreement**, **Building & Construction Permit**
- **Inspections**, **Operations**
- **Fabrication**, **Construction Documents**
- **Construction**

**RECOVERY**

- **Certificate of Occupancy**, **Move In**, **Move Out**, **Occupancy**, **HOME!**
- **Gain Access To Site**, **Public Participation**, **Occupancy HOME!**
- **Stockpile & Reuse Units**, **Builder**, **Government**, **Design Development**
Interim Housing Development

Key to Process Diagrams
The conventions shown below are used on the following pages in order to represent the various components, agency coordination, considerations, and approvals that will likely be required in the process of identifying a site, designing, permitting, and constructing interim housing in New York City.

Components and Coordination:

Considerations and Approvals:

ASSUMPTION:
Blue call-out boxes represent assumptions made to give context to this case study.

APPROVAL:
Red call-out boxes represent required approvals, permits, or waivers.

COORDINATION:
Orange call-out boxes represent specific coordination activities that will likely be required for Interim Housing beyond normal procedures.

Darker arrows and outlines represent the path of least resistance.

Lighter lines and outlines represent paths requiring more effort and approvals.
## Interim Housing Development Phase 0: Pre-Disaster Design & Permitting

### Components and Coordination

<table>
<thead>
<tr>
<th>Activities</th>
<th>Entities Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Disaster Interim Housing Plan</td>
<td>OEM, RIC, DCP, DOB, DDC, FEMA, HUD, NYCHA</td>
</tr>
<tr>
<td>Fabricator Approval</td>
<td>DOB</td>
</tr>
<tr>
<td>Unit Specification &amp; Design</td>
<td>Fabricators, OEM, DDC, DOB</td>
</tr>
<tr>
<td>Unit Review &amp; Approval</td>
<td>DOB, HPD, FNDY</td>
</tr>
</tbody>
</table>

**COORDINATION:** Establishment of a process for certification and ongoing training of architects, urban designers, landscape architects, and engineers for Interim Housing could be coordinated with DDC and DCP.

**COORDINATION:** Establishment of a pre-disaster review and approvals process for components of the prefabricated units is needed and will require further coordination with DOB.

### Coordination

- **Establishment of a process for certification and ongoing training:** This process can be coordinated with DDC and DCP.
- **Pre-disaster review and approval process:** This process is needed and will require further coordination with DOB.

### Pre-Approved Modular Units

<table>
<thead>
<tr>
<th>Pre-Disaster Planning &amp; Permitting</th>
<th>Site Selection and Preliminary Design</th>
<th>Environmental, Land Use, and Public Review</th>
<th>Final Design and Permitting</th>
<th>Construction</th>
</tr>
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</tr>
</tbody>
</table>
Fabricators are reviewed by an approved agency. Fabriсators are required to obtain approval and register with DOB. Fabriсators design units, drawings and specifications should follow the OEM performance specification and meet DOB applicable requirements. The team of special reviewers at DOB will review and approve the Units. The team of special reviewers is hypothetical at this point. Design Review 

Fabricators will need to submit a “certification of compliance” to DOB on completion of unit manufacture. Units Ready 

Units can be delivered and installed at site once site plans and final unit configurations are reviewed and approved and permits are issued. Submit Certification of Compliance 

Fabricators would need to submit a “certification of compliance” to DOB on completion of unit manufacture. Submit Certification of Compliance 

Units Ready 

Units can be delivered and installed at site once site plans and final unit configurations are reviewed and approved and permits are issued. Submit Certification of Compliance 

Fabricate Units 

Units could be manufactured pre-disaster and stored or stockpiled. Alternatively, a run of manufacture could be authorized at the time of the disaster. Fabricate Units 

Revise Drawings 

Any objections given during a DOB review must be satisfied prior to approval. 

APPROVAL: Certification by approved quality assurance agency means that fabricators have been evaluated and certified to self inspect components of the units they will be manufacturing. 

APPROVAL: DOB will need to approve and register fabricators. 

APPROVAL: DOB’s creation and approval for this pre-permitting process will be required as it does not currently exist. DOB will need to identify items to be reviewed that are specific to the units and those specific to the sites and the unit configurations. 

APPROVAL: Approvals leading to a permit to fabricate the units could be granted by DOB (if a permit to fabricate is required). However, building and construction permits could not be granted at this time and are covered in Phase 3: Final Design and Permitting.
## Interim Housing Development Phase 1: Site Selection & Preliminary Design

### Components and Coordination

<table>
<thead>
<tr>
<th>Project Identified</th>
<th>Site Identified</th>
<th>Gain Access to Site</th>
<th>Preliminary Site Design</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighborhood</td>
<td>Urban Design</td>
<td>Site Survey</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>Assessment / Site</td>
<td>Analysis</td>
<td></td>
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</tr>
<tr>
<td>Selection</td>
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<tr>
<td></td>
<td>Multi-agency mapping of post-storm conditions to identify potential sites. Factors relating to constructability and livability should be considered.</td>
<td>Analysis of site and context including: • adjacencies • access / circulation</td>
<td>Engineering Site Survey Including: • utilities / infrastructure • soil • topography • structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Implement urban design strategies to produce initial site plan.</td>
</tr>
<tr>
<td><strong>Entities Involved</strong></td>
<td>OEM, FEMA, USACE, city agencies, private sector</td>
<td>OEM, DCP, Designer, site owner</td>
<td>OEM, FEMA, USACE, Engineer, site owner</td>
</tr>
</tbody>
</table>

**Components**

- **0: Pre-Disaster Planning & Policy**
- **1: Site Selection and Preliminary Design**
- **2: Environmental, Land Use, and Public Review**
- **3: Final Design and Permitting**
- **4: Construction**

**Timeline**

- 2 - 3 weeks
SITE SELECTION: LIVABILITY CONSIDERATIONS

Exclude Permanently
The site is inappropriate for interim housing.

Investigate Further
Interim Housing is not immediately feasible, but may be possible through legal, political, or design solutions. These sites should not take priority over more easily developable sites.

Revisit Later
Interim Housing is not immediately feasible or desirable, but may become feasible as the recovery effort proceeds or desirable, if more appropriate sites are used and demand remains.

Is it free of public health hazards?
Is it big enough to support interim housing?
Will soil conditions and slope allow interim housing?
Will the owner let us use it?
Will zoning allow interim housing?

Is it on a road cleared of debris?
Is the site free of development plans?
Is it free of public health hazards?

Will environmental land use and public review considerations and approvals be met?

SITE SELECTION: BASIC CONSTRUCTABILITY CONSIDERATIONS

Is it big enough to support interim housing?
Will soil conditions and slope allow interim housing?
Will the owner let us use it?
Will zoning allow interim housing?

Is it free of public health hazards?
Is it big enough to support interim housing?
Will soil conditions and slope allow interim housing?
Will the owner let us use it?
Will zoning allow interim housing?

Is it near transit and other services?
Will soil conditions and slope allow interim housing?
Will the owner let us use it?
Will zoning allow interim housing?

APPROVAL:
Right of access will need to be granted by the site’s owner.

ENVIRONMENTAL LAND USE AND PUBLIC REVIEW

Preliminary Design
Site Survey
Urban Design Analysis
Field Verify Site (if have not already)
Are there working utilities?
Is it near transit and other services?
Is it close to home for displaced people?

APPROVAL:
Right of access will need to be granted by the site’s owner.
The proposal will need to be reviewed for compliance with local (New York City) land use laws (zoning resolution) and the necessary approvals obtained:

- zoning analysis to determine if the proposed Interim Housing is zoning compliant; if not, land use actions will be required.
- determination if other non-zoning land use actions are required.
- If land use actions are required, determine whether or not to proceed.
- undertake necessary land use review or apply for waivers, rulings or overrides necessary to expedite the process.

For this case study, it was assumed that Interim Housing would be considered standard multi-family residential for the purposes of review and permitting. Note that the zoning code does not define “interim” or “temporary” housing.

The project will need to be reviewed for compliance with applicable environmental and historic preservation laws:

- Determine if an environmental assessment is required (under CEQRA, SEQR, or NEPA)
- If required, prepare Environmental Assessment Statement based on applicable environmental law (CEQRA, SEQR, or NEPA)
- Determine findings and if an environmental impact statement (EIS) is required. If so, determine whether or not to proceed.

Land use and environmental review processes require a period of public comment or review. The length and type of public review may vary. A standard Uniform Land Use Review process takes at least seven months.

Public input on permanent redevelopment will be ongoing.

A lease, license, permit, or other agreement with the owner of the property will need to be obtained.
Interim Housing Development Phase 2: Environmental, Land Use, and Public Review
Considerations and Approvals

ASSUMPTION: Interim housing will be provided by the City of New York.

Is it zoning compliant (as of right)?

- YES
- NO

Are other land use actions required?

- YES
- NO

Is an environmental assessment required?

- NO
- YES

Environmental Assessment

ULURP actions trigger city environmental quality review (CEQR), which begins with an environmental assessment.

Does it require ULURP?

- NO
- YES

Non-ULURP Review

Other forms of land use review have different requirements than ULURP. While frequently shorter periods than ULURP, most have mandatory public review periods.

Environmental Assessment

ULURP actions trigger city environmental quality review (CEQR), which begins with an environmental assessment.

Are there significant impacts?

- YES
- NO

Environmental Impact Statement (EIS)

An EIS can significantly lengthen the review process for a project due to mandatory public review periods and present many legal and procedural hurdles.

- Land use approval will need to be granted by the city in order to proceed. Additional approvals would be needed to expedite the process.

APPROVAL:

- The lead agency must resolve that the project creates no significant adverse impact on the environment.
- Environmental findings will need to be resolved in order to proceed.

APPROVAL:

Public review is a mandatory component of the EIS process. Approval would be needed from relevant agencies to expedite the process.

APPROVAL:

The lead agency would need to determine that environmental assessment is not required because either the action qualifies as a categorical exclusion or environmental review is not triggered.

Environmental Impact Statement (EIS)

An EIS can significantly lengthen the review process for a project due to mandatory public review periods and present many legal and procedural hurdles. However, mandatory review periods can happen concurrently with land use public review periods.

Uniform Land Use Review (ULURP)

Uniform Land Use Review (ULURP) has mandatory public review periods which together amount to 215 days (over 7 months).

Negative Findings

A statement of negative findings in the form of a Finding of No Significant Impact (FONSI) or Negative Declaration.

SITE

PRELIMINARY DESIGN

FINAL DESIGN & PERMITTING
## Interim Housing Development Phase 3: Final Design and Permitting

### Components and Coordination

<table>
<thead>
<tr>
<th>Final Design</th>
<th>Design Review</th>
<th>Utilities Verification</th>
<th>Negotiate Construction Contracts</th>
<th>Obtain Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
<td><strong>Activities</strong></td>
<td><strong>Activities</strong></td>
<td><strong>Activities</strong></td>
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</table>
| Drawings and specifications meeting NYC DOB standards will need to be prepared, including, but not limited to:  
- Architecture, Builders Pavement, Landscape, Structural, MEP, HVAC, ...  
Forms including PW1 and applicable addenda will need to be prepared.  
The DOB should be consulted for the full list of requirements.  
The city requires drawings to be signed by New York State Licensed architects and engineers. | Drawings and specifications must be reviewed for compliance with:  
- Zoning (Zoning Code) - should have been vetted already in land use review  
- Egress (Building Code)  
- Multiple Dwelling Law  
- Housing Maintenance Code  
This review should be completed by the DOB, or a taskforce approved by the DOB. Drawings may need to be revised based on review.  
DOB may be able to pre-approve components of the design relating only to the modular units. A review group for such pre-approvals would need to be established at DOB and the review undertaken prior to a disaster event. | Utility connections and capacities required for the project would need to be verified with the relevant utility providers | In New York City, contractors have a safety registration with DOB.  
Depending on lead agency, there may be requirements for a public bid process. | In addition to a Building Permit, permits will be required for many construction activities including, but not limited to:  
- Erosion control  
- Use of a crane  
- Access or street closures  
- Debris / construction trash removal |
| **Entities Involved** | **Entities Involved** | **Entities Involved** | **Entities Involved** | **Entities Involved** |
| DOB, Designers, Engineers, DCP | DOB, Designer, FDNY, HPD, DEP, DSNY | DEP, ConEd, Keyspan, HPD, DSNY | OEM, FEMA, USACE, DDC | DOB, DEP, DEC, DOT, Contractor |

**COORDINATION:** Establishment of a pre-disaster review and approvals process for components of the design relating only to the prefabricated units will require further coordination with DOB.

<table>
<thead>
<tr>
<th>Pre-Disaster Planning &amp; Policy</th>
<th>Site Selection and Preliminary Design</th>
<th>Environmental, Land Use, and Public Review</th>
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<th>Construction</th>
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<td>3 - 6 weeks</td>
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Interim Housing Development Phase 3: Final Design and Permitting

Considerations and Approvals

**Final Design**
- Prepare construction documents and specifications per NYC DOB standards.

**Pre-file for Building Permit**
- Required drawings, forms will need to be submitted and checked by DOB and a fee will need to be paid. Then, the project data can be entered into the DOB database.

**Design Review**
- Review of drawings by DOB or DOB approved task force for compliance with NYC building code, multiple dwelling law, and housing maintenance code.

**Verify Utilities**
- Confirm utility connections or alternative supply.

**Obtain Building Permit**
- DOB grants building permit based on approval.

**File for Building Permit**
- Applicant must file for permit with DOB.

**Negotiate Construction Contracts**
- Construction contracts may be negotiated prior to building permit approval as contractors familiar with the NYC DOB processes may be able to assist in the process.

**Approvals**
- DOB approval is required in order to obtain a building permit. Additional approvals would be required for any deviations from code.

- Utility connections or alternative provision of utility services must be confirmed.

- Contractors must have a safety registration with DOB.

- A public bid process may be required and if so, approvals may be needed to waive or expedite this process.

- Permits for construction activities will need to be obtained from DOB, DEP and other agencies. Specific permits will depend on site and activities required.

- ADOB Requires drawings to be signed by NY state licensed professionals.

- ASSUMPTION: Drawings and specifications related to the units themselves will be provided by the unit manufacturers.
## Site Preparation

Site preparation including (as required by the site and the design):
- demolition, clearing, and grubbing or site as required.
- grading if required
- foundations

**Entities Involved:**
- Contractor, DOT, FDNY, DEP, DDC

## Unit Delivery & Installation

Units delivered to site from manufacturer, stacked, and installed.

**Activities:**
- Connect to all utilities not provided on-site.

**Inspections required for:**
- plumbing
- foundations
- structures
- materials
- mechanicals
- fire

**Entities Involved:**
- Contractor, Fabricator, DOT, DDC

## Utility Connections

**Activities:**
- DOB, FDNY, HPD, DEP, DSNY, Fabricator

## Inspections

**Activities:**
- Inspections required for:
- plumbing
- foundations
- structures
- materials
- mechanicals
- fire

**Entities Involved:**
- Contractor, ConEd, DEP, Fabricator, DDC

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### Timeline:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>Pre-Disaster Planning &amp; Policy</td>
</tr>
<tr>
<td>1</td>
<td>Site Selection and Preliminary Design</td>
</tr>
<tr>
<td>2</td>
<td>Environmental, Land Use, and Public Review</td>
</tr>
<tr>
<td>3</td>
<td>Final Design and Permitting</td>
</tr>
<tr>
<td>4</td>
<td>Construction</td>
</tr>
</tbody>
</table>
Interim Housing Development Phase 4: Construction
Considerations and Approvals

1. **FINAL DESIGN**
   - BUILDING PERMIT
     - CONSTRUCTION PERMITS

2. **Prepare Site**
   - As is necessary: demolition, clearing & grubbing, grading, foundations

3. **Deliver Units to Site**
   - Pre-manufactured units delivered to the prepared site.

4. **Install Units**
   - Units installed on site.

5. **Connect Utilities**
   - Utilities connected to units.

6. **Fix Problems**
   - Adjustments will need to be made to meet requirements.

7. **Obtain Certification of Occupancy**
   - Approval by DOB and other inspectors will be required for certification of occupancy.

8. **Inspections**
   - Inspections by DOB and others as required by the building code.

9. **RESIDENTS MOVE IN**

   - **APPROVAL:**
     - Approval by DOB and other inspectors will be required for certification of occupancy.

   - **NO**
     - NO

   - **YES**
     - YES
Where will interim housing go in the city?

Site Selection

A week after the storm, many residents of Prospect Shore and other impacted parts of the City are doubling up, staying in congregate shelters, or staying out of town. The housing stock here has been badly damaged. Existing housing resources are clearly insufficient to accommodate the displaced population. The Interim Housing plan is implemented. The process begins with site selection.

We begin by mapping what we know about Prospect Shore. We use satellite imagery, property and street maps, topography, and data on ownership, zoning, transit, and amenities.

We also map real time data sets gathered in the field by emergency operatives. This data includes utility recovery, damage assessment, debris removal, sheltering, other staging and logistics operations. We’ll also be checking in with larger city and regional efforts for long term planning and large-scale environmental remediation.

With this compiled data in hand we begin to narrow our field of options. We first consider what sites are physically feasible. From that initial set we begin to prioritize which sites are best suited for Interim Housing at the moment. Site selection will be an ongoing and iterative process. A site that is a best option on Day 7 maybe not be the best option on Day 100.

There are many regulatory and constructability issues that weigh the selection of an appropriate site. This case study follows a path of least resistance.
Constructability Considerations

Is it accessible by roads cleared of debris?

Key considerations:

- Site assessment and survey teams need to be able to get to the site.
- Trucks, cranes and other equipment necessary to deliver and construct the units need to be able to reach the site.

Immediately after the storm, Prospect Shore is blanketed with a thick layer of debris from buildings, vehicles, trees and everything else swept up in the storm surge. Search and rescue teams arrive first. They are followed by other operations including debris clearance, damage assessment, utility restoration, emergency medical care, and food and water distribution. We incorporate information from these groups with our site selection process.

We focus first on those areas that would become accessible within the first week after the storm. Such areas include sites adjacent to cleared roads, on this side of the police perimeter erected around damaged areas within which search and rescue operations continue.

There are many variables involved in the debris clearance and immediate life safety operations, so we concentrate on the sites we can identify as clear at the moment of mapping.
Constructability Considerations

Is it available?

Key considerations:

- Is the site unoccupied by buildings under repair or being rebuilt?
- Are there plans to permanently rebuild or redevelop the site within two years, or the anticipated span of interim housing?
- Is the site currently being used for other recovery efforts?

Interim Housing happens simultaneously with permanent reconstruction, and sometimes in close proximity. The use of land for interim housing is weighed against other post-disaster needs and long-term recovery plans. Some sites may be unavailable in the short-term because they are occupied by immediate recovery uses. Other sites are part of long-term recovery and reconstruction efforts and interim housing should not interfere with these plans.

We immediately exclude intact and under repair buildings as potential sites. While we retain sites with destroyed buildings and buildings slated for demolition (cleared sites) in our list of potential sites, we recognize that these would require more investigation, as long-term recovery and construction would take first priority.

Site Development Conditions:

- No Existing Structure
  - Destroyed
    - Clear
    - Demolish & Clear
  - Partially Destroyed
  - Damaged
  - Intact

- Easier
  - vacant
  - cleared

- Potentially More Difficult
  - footprint not available

ASSUMPTION:
Permanent repair and recovery takes precedence over interim housing. Sites with owners who are planning to rebuild immediately are eliminated from consideration.

COORDINATION:
Information from OEM’s damage assessment teams help identify areas where cleared land may become available in the future.

COORDINATION:
Gathering information from all post-disaster taskforces is critical to ensure that interim housing does not conflict with other recovery efforts.
Livability Considerations

Is the site safe?

Key Considerations

- Is it outside of floodways and coastal high hazard areas?
- Is it outside the 100-year flood zone?
- Is it free of designated brownfields?
- Is the site free of evident contamination hazardous to basic human health?

Many people of Prospect Shore have just undergone a traumatic event that has displaced them from their homes. Their interim housing should not expose them to further harm, whether it is flooding from another storm, or other natural or human-caused risk factors.

In identifying sites we consider key environmental risk factors that would likely result in unsafe living conditions for interim housing residents including clear contamination issues and flood hazard issues.

COORDINATION:
Damage assessment teams will be documenting areas with severe contamination and other risk factors; such areas should be excluded as potential sites.

ASSUMPTION:
Pre-existing wetland and FEMA FIRM maps should be consulted as FEMA does not traditionally fund interim housing within a floodway, coastal high hazard area, floodplain, or wetland.

COORDINATION:
Consideration should be given to coastal housing if the lowest habitable floor is raised above the 100-year flood elevation.
Constructability Considerations

Is it big enough?

Key Considerations:

- Can the site accommodate the minimum footprint, with the necessary setbacks from roads and intact or under repair buildings?

Prospect Shore is densely developed and finding sites that are large enough to support interim housing is a challenge. We assume look first for sites larger than a half acre. Sites this large meet our basic requirements for providing density with appropriate setbacks.

We look first in the areas that are accessible at the moment. We leave consideration of land that is now being cleared of storm debris and destroyed buildings to a later date when more is known about those conditions. This narrows the field of options very quickly.

ASSUMPTION:
Larger sites are preferable to smaller sites for multi-family housing.

ASSUMPTION:
The basic housing module we use is 12′x30′ per the IHPS. The basic module cluster assumed here contains four floors of three pre-manufactured modules plus circulation (per building and fire code access and egress requirements).
Constructability Considerations

Will soil conditions and slope allow interim housing?

Key considerations:

- Will the soils support structures?
- Is it sloped less than 12%?

The best sites for interim housing need minimal site preparation. Steep slopes and unstable soils require complicated foundations and sometimes lots of ramping and for accessibility.

We generate a slope map of Prospect from existing topographical information. We compile soil profiles which show the soil density and bearing capacity from individual owners.

We also determine the frost line, which helps to determine how deep any temporary foundation will need to be placed.

Slope Constraints:

- **< 2%**: Ok, but grading may be needed to ensure drainage.
- **2 - 5%**: Best, drains and easy to meet ADA requirements.
- **5 - 8%**: Good, some adjustments may need to be made for accessibility.
- **> 12%**: Bad, too steep to easily construct interim housing and access.
Constructability Considerations

Will the owner let us use it?

Key considerations:

- Can you determine the owner?
- Can you contact the owner?
- Is the owner willing to have the site used for Interim housing?

We cannot begin design without the permission of the site’s owner. It may be difficult to locate landowners; some of them are likely displaced by the storm. For this reason, we take a strong preference for publicly owned property.

Once a site is identified and owner located, survey and assessment teams request access in order to investigate it. If access is granted and the site is deemed appropriate, permission to use the site is requested.

Types of Owners:

Public
- City
- State
- Federal
- Multi-State Authority

Preferred

Private
- Individual
- Developer
- Institution
- Not-for-profit

Potentially More Difficult

Number of Owners:

1 lot → 1 owner

Preferred

multiple lots → possibly multiple owners

Potentially More Difficult

ASSUMPTION: Interim housing sites will not be purchased.

ASSUMPTION: Public ownership is preferred in order to expedite the lease process, but many public sites, especially parks and parking lots, will be occupied in the short-term by other recovery operations.
Constructability Considerations

Will zoning allow interim housing?

Key Considerations:

- Is interim housing compliant with the site’s zoning?

To determine compliance with zoning we need to have preliminary site plan which includes the height, bulk, and number of units. There are many other zoning requirements that must be considered including floor area ratios, open space ratios, residential density, and parking ratios. The Department of City Planning is consulted on questions relating to zoning.

Prospect Shore has several areas with zoning that allow 3 and 4-story multifamily residential with commercial uses on the ground floor. In this case study, we focus on an area zoned medium density residential (R6a with a commercial overlay)

Because interim housing is temporary, any negative long-term impacts of the project on the permanent character of the neighborhood should be minimal. On the contrary, we try to design interim housing in such a way to protect and heal the character of the neighborhood.

<table>
<thead>
<tr>
<th>Residential Districts:</th>
<th>May Be Compliant</th>
<th>Not Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>R6, R7, R8, R9, R10</td>
<td>May be possible to construct multifamily interim housing without violating the zoning resolution.</td>
<td>Multi-family Interim Housing as described in this case study would not be compliant with existing zoning.</td>
</tr>
<tr>
<td>R1, R2, R3, R4, R5</td>
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<table>
<thead>
<tr>
<th>Commercial Districts:</th>
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<td>C1, C2, C4, C5, C6</td>
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</tr>
<tr>
<td>C3, C7, C8</td>
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</table>

<table>
<thead>
<tr>
<th>Manufacturing Districts:</th>
<th>May Be Compliant</th>
<th>Not Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1, M2, M3</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Districts:</th>
<th>May Be Compliant</th>
<th>Not Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varies</td>
<td>(If a site is within a special district, the specific requirements of that district must be studied)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other:</th>
<th>May Be Compliant</th>
<th>Not Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mapped Parks, Mapped Streets</td>
</tr>
</tbody>
</table>
Livability Considerations

Is it close to home?

Key Considerations

- Is the site in a neighborhood where residents have been displaced?

The people in Prospect Shore want to stay close to home. They want to be with their friends and family, continue with their jobs, school, church and book clubs. Most of all, they want to take part in the reconstruction effort. That's why we are looking for an interim housing site in Prospect Shore.

We have honed in on a location that looks like it might work. We map out how close it is to the population that we believe is displaced. It seems that if we try to stay close to the higher density area, we can place housing closer to home for more people.
Livability Considerations

Is it near transit and other neighborhood services?

Key Considerations:

- Is the site within a comfortable walk of working public transit?
- Is the site within a reasonable walk or transit ride of critical neighborhood services including a hospital or clinic; schools and childcare; and a grocery, market or food distribution center?

Prospect Shore has great transit access and the people depend on it. Also, many people who do have cars have had them badly damaged in the storms.

Siting housing near working transit connections is critical in order to keep residents well connected to work, services, family, and other needs.

We also try to keep residents near services they need to rebuild. We map out the proximity of the likely site to critical services such as health care, childcare, education, groceries, and other fundamental services.

ASSUMPTION: Successful interim neighborhoods will depend on more than just housing.
Livability Considerations

Are there working utilities?

Key Considerations

- Does the site have a connection to operating power, water, sewer and telecommunications?
- If not, when are these services likely to come back on line?

Using available utility connections is preferable when possible to ensure ease and rapidity of construction. It also will provide residents with a close to normal experience.

Although it is preferable to stay “on the grid” when possible; we investigate various conventional and alternative technology options for electricity, sewerage, water, and storm water that would create on-site provision of all or part of necessary utilities. This is documented in the appendix of the case study.

We intend the interim housing to site lightly on the ground. We try to make an effort to minimize the reliance of these units on existing utilities.

ASSUMPTION: Unfortunately, the Prospect Shore Sewage Treatment Plant was badly damaged in the storm.
Field Verify Sites

The “windshield” survey

We gathered most of this information remotely from GIS and other records, so we thought it best to check it out first hand at this point.

We asked some members of a damage assessment team to verify this site in the field. Their observation confirms our information.

COORDINATION:
There will be many ongoing recovery and reconstruction efforts after the storm, other field teams may be able to perform preliminary site assessments in conjunction with other activities.
Site Typology

What are the most likely?

In the process of selecting a site, we discover that there are a variety of “types” of sites that may be available. Every site has its particular characteristics that offer constraints and opportunities for the development of Interim Housing.

We looked at ten different sites in Prospect Shore which represent ten different sites that are likely to be found in New York City.

We choose the site that has the least amount of physical, political and regulatory hurdles.

However, it is not a given that there will always be a clear “path of least resistance” in choosing a site.

The following page gives an overview of some of the particular challenges in each of the sites we examined.
PAVED LOTS:
Lots that are vacant prior to the event including parking lots or undeveloped sites.

Key regulatory hurdles:
- Zoning
- Environmental review

CLEARED LAND:
Land that was developed prior to the storm but has been cleared due to storm damage.

Key regulatory hurdles:
- Acquisition/Owner consent
- Insurance requirements
- Zoning
- Environmental review

CAMPUS IN-FILL:
Land surrounding existing buildings such as public housing and campus dorms.

Key regulatory hurdles:
- Owners' by-laws (e.g. NYCHA Section 18)
- Zoning
- Environmental review

PIER ZONE:
Water-borne housing in the area between the edge of the water and the pier line

Key regulatory hurdles:
- NYS DEC
- USACE
- USCG
- PANYNJ
- Environmental review

ADAPTIVE RE-USE:
Large buildings that can easily accommodate re-use as housing

Key regulatory hurdles:
- Owner consent
- Zoning
- Codes (Multiple Dwelling Law)
- Environmental review

SUPER BLOCK
Land spanning temporarily closed streets

Key regulatory hurdles:
- FDNY
- Zoning
- DOT (revocable consent)
- Utility easements

INFRASTRUCTURE SPACE:
Residual space around major infrastructure such as under highways.

Key regulatory hurdles:
- Zoning
- Environmental Review
- Dept. of Health (Air Quality)
- NYS DOT

ADJACENT TO PARKS:
Widened sidewalks and areas adjacent to the perimeter of park space.

Key regulatory hurdles:
- Zoning
- Dept. of Parks
- NYS DOT

PARKS:
Open space within public parks and on playing fields.

Key regulatory hurdles:
- Zoning
- Environmental Review
- Recreational
- Dept. of Parks

STREETS:
drive-lanes, parking, medians, and sidewalks

Key regulatory hurdles:
- FDNY
- Zoning
- DOT (revocable consent)
- Utility easements
What will Interim Housing look like?

Design process

Survey: Urban Design Analysis

What is the character of the neighborhood?

Good urban design starts with the street and sidewalk, the predominant public space in the city. We begin the site analysis by mapping the streets and sidewalks. We move on to map the boundaries of the site, its adjacencies, and other significant locations in the immediate area. Some of the areas the urban design analysis focuses on include:

- Pedestrian pathways
- Street activity, business restoration and provision of basic household goods.
- Building heights, street walls, setbacks and general massing
- Open space
- Street trees and other landscape or streetscape features
- Other significant locations including laundry, grocery, schools, police station, fire stations, libraries, etc.
- Distance to mass transit
- Distance to important locations for relief and recovery efforts including PODs (points of distribution for food and medicine)
Survey: detailed description of site

What are we working with?

 Appropriately accredited engineers will conduct a survey of the site. They will follow a standard procedure and try to complete a full survey as rapidly as possible.

- Metes and bounds
- Topography
- Utilities location and condition (above and below ground)
- Drainage
- Soil samples and geotechnical report to determine bearing capacity
- Coverage (soil, mixed flora, pavement, debris, infill, etc.),
- Trees and other planting
- Depth of water table and frost line
- Shade coverage and shadows (for future solar units)
- Noticeable air or noise pollution
Interim Housing Prototype
From the OEM/ DDC Interim Housing Units specification

- Multi-storey (up to 4 levels)
- 2 means of egress per unit
- Rapidly deployable and transportable
- Max. distance between unit and exit: 150'
- Can be up to aprox. 200 dwellings per acre
- Unit sizes: 10'x30', 12'x30', 10'x40', 12'x40'
Spatial parameters

**ADJACENCIES:**
15' from curb
-5' for tree pit area;
-10' for cleared sidewalk

**Water tanks**

**MAXIMIZE STREET FRONTAGE**

**HEIGHT:**
Units on street can stack to 4 floors

**3-STORY UNITS**

**ADJACENCIES:**
Min. 15' from open space

**COMMUNITY AMENITIES**

**SERVICES**

**4-STORY UNITS**

**ADJACENCIES:**
Min. 30' from adjacent buildings

**HEIGHT:**
Units not fronting street can stack to 3 floors

**15' min.**

**30' MIN.**

**10'**
“Barracks-Style” Arrangement

- Units Offset from Street
- No Clear Hierarchy of Open Space
- No Clear Zone for Retail
- Break in Streetwall
- No Clear Defensible Space
- Inefficient Cores Serving Only One Wing

120 residents/
28 dwelling units

Total No. of Modules: 72
Total No. of Stairs: 2

- 3 Bedroom units: 12
- 1 Bedroom units: 9
- 3 Bedroom handicap units: 4
- 1 Bedroom handicap units: 3
“Neighborhood-Sensitive” Arrangement

- Offset Service space for parking and loading
- Clearly defined entry and sequence of public space
- Efficient cores serve 2 wings
- Shared open space
- Repair continuity of streetwall
- Corners for retail

- 170 residents/
  35 dwelling units
- Total No. of modules: 115
- Total No. of stairs: 4

- 3 Bedroom units: 21
- 1 Bedroom units: 10
- 3 Bedroom handicap units: 4
Site Design Development

- Bicycle storage: 1 bicycle per person
- Car share: 1 car per 40 people
- 5' tree pit area
- 25' between trees
- Temporary curb cut
A Strolli Plan is a diagram showing the built environment at street level from the point of view of the pedestrian. A gradient of white (most public) to black (most private) represents where the pedestrian can most easily access.

* A complete neighborhood starts with the sidewalk

Uninterrupted rhythm of street trees

Continuity of variety in the pedestrian experience

Varied texture of building articulation at ground level
* Most important in the Strolli Plan is the indication of elements in the street (street trees, tree pits, plantings and street furniture) to quantify the sustainable elements which increase walkability.
**Zoning Compliance**

- **Building height = 56'-0”**
- **Sideyard = 30’**
- **Front wall setback = 0’**

**Parking space for 5 vehicles**

**Total FAR = 1.96**

**Total floor area = 69,300**

**Total dwelling units = 35**

**Lot area = 35,183 sq. ft.**

Lot coverage = 55%

(corner lot)

---

### Requirements

<table>
<thead>
<tr>
<th></th>
<th>Permitted in R6A</th>
<th>Proposed</th>
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<tbody>
<tr>
<td>Max. FAR</td>
<td>3.0</td>
<td>1.96</td>
</tr>
<tr>
<td>Max. Floor Area</td>
<td>105,300 sq. ft.</td>
<td>69,300 sq. ft.</td>
</tr>
<tr>
<td>Max. Building Height</td>
<td>70 ft</td>
<td>56 ft</td>
</tr>
<tr>
<td>Max. Lot Coverage (corner lot)</td>
<td>80%</td>
<td>55%</td>
</tr>
<tr>
<td>Min. Required Side Yard</td>
<td>30 ft.</td>
<td>30 ft.</td>
</tr>
<tr>
<td>Max. front wall setback for narrow street*</td>
<td>15 ft.</td>
<td>0 ft.</td>
</tr>
<tr>
<td>Permitted number of dwelling units</td>
<td>155</td>
<td>35</td>
</tr>
<tr>
<td>Parking Ratio** (50%)</td>
<td>18</td>
<td>5***</td>
</tr>
<tr>
<td>Bike Parking (1 per 2 units)</td>
<td>18</td>
<td>105</td>
</tr>
</tbody>
</table>

* cannot be less than any other building within 150 ft.
** cannot be between building and the street
*** car share offered in lieu of parking requirement
Section view

- Bicycle storage: 1 bicycle per person
- Drylines
- Bioswale
- Infrastructure units at ground level
- Bioswale
- Community garden
- 10' cleared sidewalk
- 5' tree pit area
- Screw piles foundation (reusable)
What are the next steps?

Appendix

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   HVAC and Water Heating
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   Sewage
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   Roof Investigation
   Designing for Slopes
   Site Steps/ Ramps
   Circulation and Drainage
Overview of Permits and Approvals

The table on this and the following pages present an overview of the various review processes, approvals, and permits that may be required to construct Interim Housing in compliance with New York City rules and regulations. This list should be viewed as a work in progress and will be reviewed and updated as the Interim Housing process is developed.

<table>
<thead>
<tr>
<th>Type</th>
<th>Permit / Approval / Review / Action</th>
<th>Related Documents</th>
<th>Agencies Involved</th>
<th>City process time frame (if available)</th>
<th>Notes / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental approvals (required)</td>
<td>Determination</td>
<td></td>
<td>OEC, DEP, SHPO, Landmarks, additional depending on applicable environmental law: NEPA (federal), SEQRA (state), CEQR (city). Lead agency for project</td>
<td>22 - 46* Under CEQR: Type I actions and undefined actions are subject to environmental review and an EAS is required; Type II actions are categorical exclusions and do not require environmental review. Consult the CEQR technical manual for list and descriptions of Type I and II actions. City Environmental Review should be coordinated with the OEC; Federal and State review should be coordinated with the applicable agencies. Environmental review will include consideration of historic properties and landmarks as well.*median time for City Environmental Quality Review process for projects in FY09 &amp; FY08. Note that if an Environmental Assessment Statement or an Environmental Impact Statement is required, mandatory time frames exist. For complex projects the CEQR process can take YEARS ... but in FY08&amp;09, 71% of Environmental Review Applications were completed within 6 months. source: Mayor’s Office of operations performance report on DCP.</td>
<td></td>
</tr>
<tr>
<td>Environmental approvals- (may be required)</td>
<td>Environmental Assessment (EA) (may or may not be required; this would need to be determined by the lead agency)</td>
<td>Environmental Assessment Statement or Report (EAS or EAR)</td>
<td>Lead agency with ... Depends on applicable law (NEPA, SEQRA, CEQR) NEPA: EPA, FEMA or USACE; City would likely request review of document by DEP SEQRA: DEC, Agency in charge of project; City would likely request review of document by DEP CEQR: OEC, DEP, Agency in charge of project All: SHPO, Landmarks</td>
<td></td>
<td>City environmental review is mandated for actions directly undertaken by the city or for which a city provides financial assistance. City environmental review is not mandated for as of right construction. FEMA may require an EA under NEPA for actions they undertake or fund. Action</td>
</tr>
<tr>
<td>Type</td>
<td>Permit / Approval / Review / Action</td>
<td>Related Documents</td>
<td>Agencies Involved</td>
<td>City process time frame (if available)</td>
<td>Notes / Comments</td>
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<td></td>
<td></td>
<td></td>
<td>Required min. time (days)</td>
<td>Median time (days)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental approvals - (may be required)</td>
<td>Statement of Findings</td>
<td>Negative NEPA: Finding of No Significant Impact (FONSI) CEQR: Negative Declaration</td>
<td>30</td>
<td></td>
<td>No EIS required. CEQR requires the lead agency give public notice of a negative declaration and provide a 30-day public comment period.</td>
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<tr>
<td></td>
<td></td>
<td>Negative with conditions: NEPA: FONSI with Mitigation CEQR: Conditional Negative Declaration</td>
<td>30</td>
<td></td>
<td>No EIS required as long as conditions are met. CEQR requires the lead agency give public notice of a conditional negative declaration and provide a 30-day public comment period.</td>
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<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>ibid</td>
<td></td>
<td>Environmental Impact Statement is required</td>
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<tr>
<td>Environmental Impact Statement (EIS) (only required if there are positive findings from the EA)</td>
<td>Scope of Work</td>
<td>ibid</td>
<td>40</td>
<td>Minimum 30 days, maximum 45 between statement of findings and public scoping meeting, 10 days after meeting to receive comments. Maximum 30 days after public scoping meeting to publish scope of work</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Draft Environmental Impact Statement (DEIS)</td>
<td>ibid</td>
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<tr>
<td></td>
<td></td>
<td>Public Review Period</td>
<td>ibid</td>
<td>30</td>
<td>*Depends on applicable law / procedure, but there are mandatory public review periods. Public review under CEQR can happen concurrently with land use review.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final Environmental Impact Statement (FEIS)</td>
<td>ibid</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Findings</td>
<td>ibid</td>
<td>10</td>
<td>must be minimum of 10 days between issueing of FEIS and written findings</td>
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<tr>
<td>Land Use Approvals (required)</td>
<td>Zoning compliance review</td>
<td>ZD1 Zoning Diagram and Form^</td>
<td>DOB, DCP</td>
<td>33 - 48*</td>
<td>*This is the building permit form (see building permit section). Review for compliance with zoning code typically happens as part of the building permit process, but we would want to initiate process as soon as possible once a site has been identified.</td>
</tr>
<tr>
<td>Land Use Approvals (may be required)</td>
<td>ULURP (only required if not compliant or certain other cases, see DCP)</td>
<td>Application and Pre-Certification</td>
<td>DCP</td>
<td></td>
<td>Other actions besides violation of the zoning resolution may trigger ULURP; for a list of actions triggering ULURP, consult DCP (list also available at: <a href="http://www.nyc.gov/html/dcp/html/ulurp/ulpro.shtml">http://www.nyc.gov/html/dcp/html/ulurp/ulpro.shtml</a>) Other Land Use actions may be required besides ULURP; other forms of land use review have different requirements than ULURP. While frequently shorter periods than ULURP, most have mandatory public review periods. DCP should be consulted on all zoning compliance and land use questions. For a complete description of the ULURP Procedure, see <a href="http://www.nyc.gov/html/dcp/html/ulurp/ulpro.shtml">http://www.nyc.gov/html/dcp/html/ulurp/ulpro.shtml</a></td>
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<td>Community Board Review</td>
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<td>60</td>
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<td></td>
<td></td>
<td>Borough President Review</td>
<td>Borough President (and sometimes borough board)</td>
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<td>City Planning Commission Review</td>
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<td>City Council review</td>
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<td>Mayor review</td>
<td>Mayor’s Office</td>
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<td></td>
<td></td>
<td>City Council review</td>
<td>City Council</td>
<td>10</td>
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</tr>
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</table>

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<th>Agencies Involved</th>
<th>City process time frame (if available) Required min. time (days) Median time (days) Notes / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building, Construction, and Inspections</td>
<td>The following series of permits, approvals and reviews all relate to the DOB permitting and approval process. The application process at this point is tracked through the Building Information System (BIS) at DOB. There are an extremely large number of potentially required items, not all of which will be applicable in every case. The PC1 Required Items Checklist provides a list of potentially required items, and can be found online, along with other DOB forms and permits, at: <a href="http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1">http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1</a>. A list and description of specific required items and when they are applicable can be found in the DOB’s “Required Items Reference Guide,” Available online at: <a href="http://www.nyc.gov/html/dob/html/guides/required_items_reference_guide.shtml">http://www.nyc.gov/html/dob/html/guides/required_items_reference_guide.shtml</a>. Note for both permits and inspections, some of the required inspections may be dealt with through the process being developed for the design and approval of prefabricated modular units, and addressed prior to the disaster event, while others will not be addressed until site design and construction. DOB will need to be consulted in order to determine which items are which and establish an approval process specific for Interim Housing.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Building &amp; Construction Permit Approvals</td>
<td>Pre-file application for Building Permit</td>
<td>complete drawing set</td>
<td>DOB</td>
<td>110 (city-wide average or median (confirm with DOB) for buildings with more than 3 dwelling units for period Jan 2008 - May 2010)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PW1 Plan / Work Approval Application Form</td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PD1 Plot Diagram Form</td>
<td>DOB</td>
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<td></td>
<td>ZD1 Zoning Diagram Form</td>
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<tr>
<td></td>
<td></td>
<td>Additional PW1 Addendums</td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pay Fee</td>
<td></td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application Entered into BIS</td>
<td></td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DOB Reviews application</td>
<td></td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DOB will consult with DCP, HPD, FDNY, and other agencies as needed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Signoffs and Permits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DOB Approves Application</td>
<td></td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction Permits</td>
<td>Multiple, refer to DOB for required items based on project</td>
<td>DOB, DEP, FDNY, and others depending on project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional Permits</td>
<td>Multiple, refer to DOB for required items based on project</td>
<td>DOB and others</td>
<td></td>
</tr>
<tr>
<td>File &amp; Obtain Building Permit</td>
<td>Approved documents from review</td>
<td></td>
<td>DOB</td>
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<tr>
<td></td>
<td>PW-2 Permit Application Form</td>
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<td></td>
<td>PW-3 Cost Affidavit Form</td>
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<td>DOB</td>
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<td></td>
<td>Fee Payment</td>
<td></td>
<td>DOB</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Permit / Approval / Review / Action</td>
<td>Related Documents</td>
<td>Agencies Involved</td>
<td>City process time frame (if available)</td>
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<td>------------------------</td>
<td>------------------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Inspections</td>
<td>inspections</td>
<td>OP-98 Notice results form</td>
<td>DOB, Special Inspectors, FDNY, DEP, ConEd, DOHMH, HPD, additional agencies may be involved depending on project details and location</td>
<td>Required min. time (days)</td>
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<tr>
<td></td>
<td>additional inspections</td>
<td>additional Inspections</td>
<td></td>
<td>Median time (days)</td>
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<tr>
<td>Certification of Occupancy</td>
<td>application for certificate of occupancy</td>
<td>PW6 Certificate of Occupancy Application</td>
<td>DOB</td>
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<tr>
<td>Certificate of Occupancy</td>
<td>PW7 Certificate of Occupancy / Letter of Completion Folder Review Request</td>
<td>DOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary Certificate of Occupancy</td>
<td>PW7 Certificate of Occupancy / Letter of Completion Folder Review Request</td>
<td>DOB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Site Selection Data

Site selection will be aided by being able to rapidly gather and map both pre and post storm information about the city and its neighborhoods as well as the storm’s impact. The table below lists data categories that will likely be critical to identifying and evaluating potential sites for post-disaster interim housing. The corresponding City Environmental Quality Review (CEQR) technical category is also listed, which will aid in coordinating information if environmental assessment is required.

<table>
<thead>
<tr>
<th>Site Selection &amp; Assessment Categories</th>
<th>Related Environmental Assessment - CEQR Technical Analysis - category</th>
<th>Data Required</th>
<th>Probable Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data that will need to be gathered or updated post-disaster</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerial / satellite Imaging</td>
<td>none</td>
<td>Post storm aerial or satellite images</td>
<td>USACE, google</td>
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<tr>
<td>Post Disaster Damage Assessment &amp; Recovery Activities</td>
<td>none</td>
<td>Building damage assessment - structures remaining, structures destroyed, and status of repair or clearance</td>
<td>OEM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Debris clearance - areas covered and areas cleared</td>
<td>OEM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sheltering - location of shelters, and number and info of individuals and families being housed</td>
<td>OEM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distribution and logistics center locations</td>
<td>OEM</td>
</tr>
<tr>
<td>Transportation &amp; Access</td>
<td>Transportation (13)</td>
<td>Cleared Roads - primary routes, secondary roads &amp; streets</td>
<td>OEM, USACE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roads and Streets - ROW and carriageway widths</td>
<td>DOT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traffic capacities - check with CEQR</td>
<td>DOT, MTA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public Transit - working subway stations, operating &amp; predicted to be operational bus routes</td>
<td>MTA</td>
</tr>
<tr>
<td></td>
<td>none</td>
<td>Evacuation routes</td>
<td>OEM</td>
</tr>
<tr>
<td>Site Selection &amp; Assessment Categories</td>
<td>Related Environmental Assessment - CEQR Technical Analysis - category</td>
<td>Data Required</td>
<td>Probable Data Source</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------------------------------------------------------</td>
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<td>---------------------</td>
</tr>
<tr>
<td>Utilities (power, water, sewerage, stormwater, and telecom)</td>
<td>Water and Sewer Infrastructure (10)</td>
<td>Sewage System - working lines, working treatment locations, and capacity by treatment plant or coverage area</td>
<td>DSNY, OEM, USACE</td>
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<tr>
<td></td>
<td></td>
<td>Water Supply - working lines and potability</td>
<td>DEP, ?, OEM, USACE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water Supply - alternative water sources</td>
<td>OEM, USACE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water - working fire hydrants</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Storm sewer systems - drainage, capacity, and level of function</td>
<td>DEP, ?, OEM, USACE</td>
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<tr>
<td></td>
<td>Energy (12)</td>
<td>Electricity - working lines and capacity by section</td>
<td>ConEd, OEM, USACE</td>
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<tr>
<td></td>
<td></td>
<td>Electricity - sites with or with potential for alternative energy generation</td>
<td></td>
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<tr>
<td></td>
<td>none</td>
<td>Telecom - working hardlines</td>
<td>Verizon, ?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telecom - cellular / wifi coverage</td>
<td>Cellular Providers</td>
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<tr>
<td>Community Facilities &amp; Services</td>
<td>Community Facilities &amp; Services (3)</td>
<td>Healthcare - working hospitals and clinics</td>
<td>DHMH, universities, private sector</td>
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<tr>
<td></td>
<td></td>
<td>Education - open and predicted to reopen public schools</td>
<td>DOE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Childcare - open and predicted to reopen child care centers</td>
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<tr>
<td></td>
<td></td>
<td>Libraries - open and predicted to reopen libraries</td>
<td>NYCPL</td>
</tr>
<tr>
<td></td>
<td>none</td>
<td>Food - working groceries, farmers markets, and food distribution sites</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Culture - community centers and churches</td>
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<td></td>
<td>Open space (4)</td>
<td>Open space &amp; recreation - open public parks and recreational facilities</td>
<td>DPR</td>
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<tr>
<td>Security &amp; Emergency Services</td>
<td>Community Facilities &amp; Services (3)</td>
<td>Emergency services - working fire stations</td>
<td>FDNY</td>
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<tr>
<td></td>
<td></td>
<td>Security - working police stations</td>
<td>PDNY</td>
</tr>
<tr>
<td>Environmental Quality</td>
<td>Hazardous Materials (9)</td>
<td>Visible contamination / hazardous materials on-site</td>
<td>DEP, OEM, USACE</td>
</tr>
<tr>
<td>Site Selection &amp; Assessment Categories</td>
<td>Related Environmental Assessment - CEQR Technical Analysis - category</td>
<td>Data Required</td>
<td>Probable Data Source</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------------------------------------------</td>
<td>---------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Existing, Pre-Disaster Data</td>
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<tr>
<td>Critical FEMA Information</td>
<td>FEMA flood zones</td>
<td>FEMA (pre storm)</td>
<td></td>
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<tr>
<td></td>
<td>Floodways</td>
<td>FEMA (pre storm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coastal high hazard areas</td>
<td></td>
<td></td>
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<tr>
<td>Natural Resources (8)</td>
<td>Wetlands</td>
<td>FEMA (pre storm)</td>
<td></td>
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<tr>
<td>Physical Conditions</td>
<td>none</td>
<td>Topography / Slope</td>
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<tr>
<td></td>
<td></td>
<td>Soil Stability</td>
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<tr>
<td>Ownership</td>
<td>none</td>
<td>Ownership (public: city, state, regional, or federal agency; Private)</td>
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<tr>
<td></td>
<td>none</td>
<td>Ownership - owner contacts, including if in New York post-storm</td>
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<tr>
<td>Land Use, Zoning &amp; Public Policy</td>
<td>none</td>
<td>Location of relief &amp; recovery effort land uses, including: debris storage locations, point of distribution centers</td>
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<tr>
<td></td>
<td>Land Use, Zoning &amp; Public Policy (1)</td>
<td>Current land use (post storm)</td>
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<tr>
<td></td>
<td></td>
<td>Pre-storm landuse</td>
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<tr>
<td></td>
<td></td>
<td>Zoning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NYC Waterfront</td>
<td></td>
</tr>
<tr>
<td>Community Context</td>
<td>none</td>
<td>Pre-storm location of displaced persons - housing destroyed or evacuated and unable to return due to the storm</td>
<td></td>
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<tr>
<td></td>
<td>Socioeconomic conditions (2)</td>
<td>Inhabited / working residential, commercial, or industrial activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighborhood character (18)</td>
<td>Surrounding building types &amp; heights, land use, demographics</td>
<td></td>
</tr>
<tr>
<td>Historic, Cultural, Design, Visual, and Natural Resources</td>
<td>Shadows (5)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Historic and Cultural Resources (6)</td>
<td>Historically or culturally significant NYC properties - New York City Landmarks, Interior or Scenic Landmarks, New York State and National Register or Historic Places</td>
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<td></td>
<td>Urban Design and Visual Resources (7)</td>
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<td></td>
<td>Natural Resources (8)</td>
<td>Natural resources - check with CEQR</td>
<td></td>
</tr>
<tr>
<td>Site Selection &amp; Assessment Categories</td>
<td>Related Environmental Assessment - CEQR Technical Analysis - category</td>
<td>Data Required</td>
<td>Probable Data Source</td>
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<tr>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------</td>
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<tr>
<td><strong>Environmental Quality</strong></td>
<td>Hazardous Materials (9)</td>
<td>Designated brownfields</td>
<td>DEP, OEC</td>
</tr>
<tr>
<td></td>
<td>Prior land uses involving use of hazardous materials - ie cleaners, heavy industrial, etc</td>
<td>DCP</td>
<td></td>
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<tr>
<td></td>
<td>Sites with institutional controls - ie. Restrictive declarations</td>
<td>DCP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presence of underground storage tanks</td>
<td>DEP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental justice communities</td>
<td></td>
<td></td>
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<td></td>
<td>Air Quality (14)</td>
<td>check with CEQR</td>
<td>DEP</td>
</tr>
<tr>
<td></td>
<td>Greenhouse Gas Emissions (15)</td>
<td>check with CEQR</td>
<td>DEP</td>
</tr>
<tr>
<td></td>
<td>Noise (16)</td>
<td>check with CEQR</td>
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<tr>
<td></td>
<td>Public Health (17)</td>
<td>check with CEQR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction Impacts (19)</td>
<td></td>
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</table>
## List of Agencies and Acronyms

<table>
<thead>
<tr>
<th>Government Level</th>
<th>Agency</th>
<th>Acronym</th>
</tr>
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<tbody>
<tr>
<td><strong>City / Local</strong></td>
<td>Office of Emergency Management</td>
<td>OEM</td>
</tr>
<tr>
<td></td>
<td>NYC Department of City Planning</td>
<td>DCP</td>
</tr>
<tr>
<td></td>
<td>NYC Department of Buildings</td>
<td>DOB</td>
</tr>
<tr>
<td></td>
<td>NYC Department of Design and Construction</td>
<td>DDC</td>
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<tr>
<td></td>
<td>Fire Department of NYC</td>
<td>FDNY</td>
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<td></td>
<td>Police Department of NYC</td>
<td>NYPD</td>
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<tr>
<td></td>
<td>NYC Housing Authority</td>
<td>NYCHA</td>
</tr>
<tr>
<td></td>
<td>NYC Housing Preservation and Development</td>
<td>HPD</td>
</tr>
<tr>
<td></td>
<td>NYC Mayors Office of Environmental Coordination</td>
<td>OEC</td>
</tr>
<tr>
<td></td>
<td>NYC Department of Environmental Protection</td>
<td>DEP</td>
</tr>
<tr>
<td></td>
<td>NYC Department of Transportation</td>
<td>DOT</td>
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<tr>
<td></td>
<td>NYC Department of Sanitation</td>
<td>DSNY</td>
</tr>
<tr>
<td></td>
<td>NYC Landmarks Preservation Commission</td>
<td>LPC</td>
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<td></td>
<td>NYC Department of Parks and Recreation</td>
<td>DPR</td>
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<tr>
<td></td>
<td>NYC Department of Health and Mental Hygiene</td>
<td>DOHMH</td>
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<td></td>
<td>NYC Department of Education</td>
<td>DOE</td>
</tr>
<tr>
<td></td>
<td>NYC Board of Standards and Appeals</td>
<td>BSA</td>
</tr>
<tr>
<td></td>
<td>NYC Economic Development Corporation</td>
<td>EDC</td>
</tr>
<tr>
<td><strong>Regional / Metro</strong></td>
<td>Port Authority of New York and New Jersey (PANYNJ)</td>
<td>PANNYNJ</td>
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<td></td>
<td>Metropolitan Transportation Authority (MTA)</td>
<td>MTA</td>
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<tr>
<td><strong>State</strong></td>
<td>New York State Emergency Management Office</td>
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<tr>
<td></td>
<td>New York State Department of Environmental Conservation</td>
<td>DEC</td>
</tr>
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<td></td>
<td>New York State Department of Transportation</td>
<td>NYS DOT</td>
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<td></td>
<td>State Historic Preservation Office</td>
<td>SHPO</td>
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<tr>
<td><strong>Federal</strong></td>
<td>Federal Emergency Management Agency (FEMA)</td>
<td>FEMA</td>
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<tr>
<td></td>
<td>United States Army Corps of Engineers (USACE)</td>
<td>USACE</td>
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<td></td>
<td>Department of Environmental Protection</td>
<td>EPA</td>
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<td></td>
<td>Department of Housing and Urban Development</td>
<td>HUD</td>
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<td></td>
<td>White House Council on Environmental Quality (CEQ)</td>
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<tr>
<td></td>
<td>National Weather Service</td>
<td>NWS</td>
</tr>
<tr>
<td></td>
<td>Coast Guard</td>
<td>USCG</td>
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<tr>
<td></td>
<td>National Guard</td>
<td>USNG</td>
</tr>
</tbody>
</table>
A disaster event, although devastating to a community, will provide opportunities for implementing more efficient and sustainable technologies than are usually attempted during typical planning and reconstruction. Renovating and rebuilding necessary services and infrastructure with these technologies can substantially change the direct and indirect impacts we have on our natural systems. Interim Housing Units should not only be equipped to function during a post disaster situation where infrastructure is limited or not available, but should be designed to ‘sit lightly’ for the entire life of their use.

### Infrastructure Overview

Disaster Housing is GREEN!

<table>
<thead>
<tr>
<th></th>
<th>Interim Housing Unit</th>
<th>Average NYC Apartment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bedrooms</strong></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Number of Inhabitants</strong></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Square Footage</strong></td>
<td>720 ft²</td>
<td>1,500 ft²</td>
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<tr>
<td><strong>Energy Consumption</strong></td>
<td>10 kW/day</td>
<td>10 kW/day</td>
</tr>
<tr>
<td></td>
<td>- 9 kW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 kW/ day</td>
<td></td>
</tr>
<tr>
<td><strong>Water Demand</strong></td>
<td>180 gal/day</td>
<td>180 gal/day</td>
</tr>
<tr>
<td></td>
<td>-22% washing machines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-18% conventional</td>
<td></td>
</tr>
<tr>
<td></td>
<td>toilets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2.7% baths</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.5 dishwashers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>102 gal/day</td>
<td></td>
</tr>
<tr>
<td><strong>Garbage Removal</strong></td>
<td>64.4 lbs/ week</td>
<td>64.4 lbs/ week</td>
</tr>
<tr>
<td></td>
<td>-39% organics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-36% recyclable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16 lbs/ week</td>
<td></td>
</tr>
<tr>
<td><strong>Human Waste Removal</strong></td>
<td>22.4 gal/week</td>
<td>22.4 gal/week</td>
</tr>
<tr>
<td></td>
<td>of human waste</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-69% composted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ 226.8 gal/week of flush water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 gal/week of non-toxic filtered liquid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>249.2 gal/ week of sludge</td>
<td></td>
</tr>
</tbody>
</table>

Communal washing machines run off of rainwater catchment system. Foam flush toilets use 95% less water than conventional toilets. Baths and dishwashers not provided in units. Organics can be disposed of in composting toilet system. Recycling system available on site. Garbage Removal: 64.4 lbs/ week -39% organics -36% recyclable 16 lbs/ week Human Waste Removal: 22.4 gal/week of human waste -69% composted + 226.8 gal/week of flush water 7 gal/week of non-toxic filtered liquid 249.2 gal/ week of sludge
**Infrastructure Overview**

**Damage Assessment & Strategies**

**ELECTRICITY**
- **100% function of all pre-existing utilities**: No need for power generating systems.
- **100% Stable with sudden but infrequent blackouts**: Grid connection available. On-site generators where necessary.
- **>80%**: Frequent, short-term blackouts—entire community is affected. Solar introduced to help relieve energy demands from grid. Generators brought on site for back-up.
- **>50%**: Cannot reach demand; begin dividing electric supply by alternating hourly schedule to all communities. Solar providing basic energy needs to nearly all locations. Generators start taking heavier loads (pumping water, etc.)
- **>40%**: Not all neighborhoods are reached with available electric supply; some receive short intervals of service only. Solar power and bio-diesel generators working to full capacity.
- **>20%**: 0% function of pre-existing utilities
- **0%**: 0% function of pre-existing utilities

**WATER**
- **100% function of all pre-existing utilities**: Access to city water fully established. No need for additional systems.
- **Access to city water**: Grid connection available. On-site generators where necessary.
- **>80%**: Entire population experiencing temporary short-term (12-24 hrs) loss. Water catchment systems introduced on an as-needed basis. In-home filtration and purification.
- **>50%**: Increased truck deliveries. Water catchment systems installed at all locations. Beginning the process of on-site filtration and purification.
- **>40%**: Very infrequent access to city water; dry spells up to 1.5 weeks long may be experienced. Water catchment systems installed at all locations. Beginning the process of on-site filtration and purification.
- **>20%**: 0% function of pre-existing utilities
- **0%**: 0% function of pre-existing utilities

**SEWER**
- **100% function of all pre-existing utilities**: Sewer available for connection.
- **Sewer functioning to full capacity—excluding certain low-lying flood zone neighborhoods**: Sewer available for connection.
- **>80%**: Operating but with proposal to flush conservatively. Occasional street sewage overflows, but quick to repair
- **>50%**: Sudden and increasing frequency sewer overflows. Introduce composting units to areas where sewer is in disrepair. Liquid by-product line connected directly to sewer.
- **>40%**: Sewage operating at over capacity due to disrepair. Some streets experiencing regularly occurring street sewage overflows. Composting units installed on all sites. Liquid by-product lines connected to sewer where available.
- **>20%**: Sewage operating at over capacity due to disrepair. Some streets experiencing regularly occurring street sewage overflows. Composting units installed on all sites. Liquid by-product lines connected to sewer where available.
- **0%**: 0% function of pre-existing utilities
Module Organization

Service Units

To support living needs in an efficient manner, service units can be strategically located under unit clusters to serve the most residents possible.

Message boards placed on facades of the service units can improve wayfinding and orientation for residents.

Keeping the infrastructure components like fuel storage, generators, composters, water tanks, and other storage and services together in a specifically zoned area can provide efficiency in delivery, maintenance, and fume and noise mitigation.
Module Organization

Clustering Around Units

An efficient cluster of modules will have the maximum number of people served by one service unit.

As seen in the Module Density table (below), a 3 module cluster is much more efficient than a 4 module cluster as necessary site areas and energy consumption per person decreases.

In order to maximize the density of people on site, it is preferable to house larger families. Although, with a given number of family sizes the site most likely will have to accommodate for larger and smaller families.

<table>
<thead>
<tr>
<th>Module Density</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Service Modules, SM</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Necessary Site Area(^2) (ft(^2))</td>
<td>1,670</td>
<td>2,175</td>
<td>2,680</td>
<td>3,845</td>
<td>4,350</td>
<td>4,850</td>
<td>5,355</td>
<td>5,860</td>
<td>5,355</td>
<td>5,860</td>
<td>6,365</td>
</tr>
<tr>
<td>People (max.)</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>20</td>
<td>24</td>
<td>16</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Energy Consumption (kW/day)</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>40</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Water Demand(^2) (gal/day)</td>
<td>68</td>
<td>136</td>
<td>136</td>
<td>204</td>
<td>272</td>
<td>272</td>
<td>340</td>
<td>408</td>
<td>272</td>
<td>340</td>
<td>408</td>
</tr>
<tr>
<td>Produced Garbage (lbs/day)</td>
<td>9</td>
<td>18</td>
<td>18</td>
<td>28</td>
<td>37</td>
<td>37</td>
<td>46</td>
<td>55</td>
<td>37</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>Produced Human Waste (gal/day)</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>13</td>
<td>13</td>
<td>16</td>
<td>19</td>
<td>13</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Produced Grey Water (gal/day)</td>
<td>62</td>
<td>125</td>
<td>125</td>
<td>187</td>
<td>249</td>
<td>249</td>
<td>312</td>
<td>374</td>
<td>249</td>
<td>312</td>
<td>374</td>
</tr>
<tr>
<td>Available Solar Energy(^2) (kW)</td>
<td>9</td>
<td>13</td>
<td>17</td>
<td>23</td>
<td>26</td>
<td>30</td>
<td>34</td>
<td>38</td>
<td>34</td>
<td>38</td>
<td>42</td>
</tr>
<tr>
<td>Available Rain Collection (gal/year)</td>
<td>31,380</td>
<td>43,935</td>
<td>56,490</td>
<td>75,320</td>
<td>87,870</td>
<td>100,425</td>
<td>112,980</td>
<td>125,530</td>
<td>112,980</td>
<td>125,530</td>
<td>138,085</td>
</tr>
</tbody>
</table>
**Systems Guidelines**

**Energy recommendations**

- Connect to grid as soon as possible
- Reduce consumption
  - Cap supply per unit
  - Limit high load appliances
    (i.e. Limit accessible wattage per unit)
  - Provide on-site cooling center, laundry service, cable TV center
- Use low demand, energy efficient technologies
  - Lighting (LED, CFL, etc.)
  - HVAC
  - Water heating
    - Appliances with energy star rating
- Implement community education on energy conservation
  - Shut off and unplug
    - “How to” decrease daily use
- Deploy targeted renewable energy supply systems
- Provide generators/fuel tanks as last resort
- Define maximum electrical demand
  - Per unit
  - Per site
- Define maximum
  - Fuel demand, storage and delivery protocol (gal/day)
- Consider location on site, structural shelter, and noise/exhaust mitigation
- Install cogeneration capabilities

**HVAC & Water Heating Guidelines**

- Define BTU and hot water demand
  - per unit
  - per site
- Choose appropriate system
  - modular
  - centralized
Systems Guidelines

Water Use Recommendations

• Connect to grid as soon as possible
• Reduce consumption
• Cap supply per unit
  - Provide on-site laundry center
  - Regulate water availability
  - Design strategies
  - Use low demand water efficient technologies
  - Use foam flush composting toilets or low flow toilets
  - Restricted flow water nozzles
  - Use appliances with energy star rating
• Implement community education on energy conservation
  - Water conservation
  - Dish washing
  - Showering
  - Teeth brushing and hand washing
  - Toilet flushing
  - Appropriate cleaning techniques
• Define maximum demand per unit and site (gal/day)
• Size and install water tanks
• Construct catchment system

If supply fulfills demand:
  - Install on site water purification system (i.e. Ozonation)
  - Distribute water to units
  - Cease water delivery
If supply cannot reach demand:
  - Store rain catchment for laundry use only
  - Proceed to water delivery protocol
  - Provide water delivery to site
  - Implement tank refill delivery protocol (gal/week)
Systems Guidelines

Sewerage Recommendations

If sewage connection available:
• Conduct sewer connection feasibility study
• Install above ground sewer lines
  Gravity flow
  Sub pumps/energy necessary
• Excavate for connection to existing sewer line
• Water availability (water demand for flushing toilets)

If sewage connection not available:
• Conduct sewage retention basin feasibility study
  Above ground basin location and spatial parameters
  Necessary pumping/energy
  Daily-hourly waste extraction protocol
• Conduct compost feasibility study
  Location and spatial parameter in unit configuration
  Minimum temp. Requirements
  Monthly maintenance
  Community education on new technology
  Biannual liquid extraction protocol
## Infrastructure Menu

The following table represents a matrix of available energy systems for the Interim Housing Unit. Different configurations of systems can be paired together to achieve the most integrated and efficient scheme.

<table>
<thead>
<tr>
<th>Description</th>
<th>Generator</th>
<th>Microturbine Generator</th>
<th>PV Electric</th>
<th>Residential Wind Turbine</th>
<th>Hydrogen Fuel Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric energy produced from fuel combustion</td>
<td>Electric energy produced by small combustion turbines</td>
<td>Electricity produced from sunlight through photovoltaic cell systems</td>
<td>Electricity produced from the collected kinetic energy of wind</td>
<td>Energy conversion device that can capture and use the power of hydrogen</td>
<td></td>
</tr>
<tr>
<td>Fuel Type</td>
<td>gasoline, diesel, biodiesel, nat. gas</td>
<td>gasoline, diesel, biodiesel, nat. gas</td>
<td>none</td>
<td>none</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Time to implement</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Time lead to install</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Poor</td>
<td>Poor</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cost to operate</td>
<td>Poor</td>
<td>Poor</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Availability</td>
<td>Excellent</td>
<td>Medium</td>
<td>Medium</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Safety Concerns</td>
<td>Medium (fuel spills possible)</td>
<td>Medium (fuel spills possible)</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Noise</td>
<td>Poor</td>
<td>Poor</td>
<td>Excellent</td>
<td>Medium</td>
<td>Excellent</td>
</tr>
<tr>
<td>Fumes</td>
<td>Poor</td>
<td>Poor</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Operating Maintenance</td>
<td>Poor</td>
<td>Medium (less moving parts than std. generator)</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Capacity Available</td>
<td>up to 2000 kW</td>
<td>up to 2000 kW</td>
<td>0.01 kW / ft²</td>
<td>1.5 - 3 kW ea.</td>
<td>up to 150 kW</td>
</tr>
<tr>
<td>Description</td>
<td>Heat</td>
<td>Ventilation</td>
<td>Air Condition (AC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
<td>-------------</td>
<td>--------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralized</td>
<td>Decentralized (living unit)</td>
<td>Centralized</td>
<td>Decentralized (living unit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Boilers</td>
<td>Electric Baseboards</td>
<td>Mini Split System</td>
<td>Central Air</td>
<td>Passive Cooling</td>
<td>Room Air Conditioner</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Creates heat through electric energy supply</td>
<td>Heats through exterior heat pump</td>
<td>Air condensing unit cools and distributes air</td>
<td>Using architecture to inhibit air flow through building</td>
<td>Air condensing unit cools and distributes air</td>
</tr>
<tr>
<td><strong>Time lead time for installation</strong></td>
<td>Medium</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Medium</td>
<td>Excellent (inherent in unit design)</td>
</tr>
<tr>
<td><strong>Cost to implement</strong></td>
<td>Excellent (standard technology)</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Cost to operate</strong></td>
<td>Excellent</td>
<td>Medium (constant energy demand)</td>
<td>Medium</td>
<td>Medium</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>Medium</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td>Medium</td>
<td>Excellent</td>
<td>Medium</td>
<td>Medium</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Estimated Life Time</strong></td>
<td>10-20 years</td>
<td>20 years</td>
<td>10 years</td>
<td>15-20 years</td>
<td>life of building</td>
</tr>
</tbody>
</table>

It is assumed that ventilation will be properly designed for in all kitchens and bathrooms by the manufacturer.
<table>
<thead>
<tr>
<th></th>
<th>Combined Heat &amp; Power (CHP)</th>
<th>Geothermal</th>
<th>Domestic Hot Water (DHW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Centralized</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Decentralized (living unit)</td>
</tr>
<tr>
<td><strong>Cogeneration</strong></td>
<td>[Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Harnesses captured heat losses from an engine generator</td>
<td>Harvests thermal energy underneath earth’s surface</td>
<td>Electric supply maintains a constant water temp. in storage tank</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>Medium</td>
<td>Poor</td>
<td>Excellent</td>
</tr>
<tr>
<td>lead time for installation</td>
<td>Medium (excavation necessary)</td>
<td>Poor (design intensive)</td>
<td>Medium</td>
</tr>
<tr>
<td>Cost</td>
<td>Medium</td>
<td>Poor</td>
<td>Excellent</td>
</tr>
<tr>
<td>to implement</td>
<td>Medium</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Excellent</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>to operate</td>
<td>Excellent</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Excellent (naturally available source)</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Availability</td>
<td>Medium</td>
<td>Medium</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Noise</td>
<td>Medium</td>
<td>Excellent</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excellent</td>
</tr>
<tr>
<td>Estimated Life Time</td>
<td>20-30 years (interior components)</td>
<td>25 years</td>
<td>10-20 years</td>
</tr>
<tr>
<td></td>
<td>50 years (exterior components)</td>
<td>15-20 years</td>
<td>20 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15 years</td>
</tr>
</tbody>
</table>

NOTE: Choosing between centralized and decentralized systems is extremely dependent on the demand. For most cases, decentralized systems operate more efficiently with low demands and centralized systems with high demands.
Site Design Techniques

Foundation Investigation

Screw piles (Helical)
- Fast installation
- All weather installation
- Removable
- Reusable

Precast concrete plank on grade
- No soil penetration
- May require grading
- May be insufficient for load

Slab on grade with base isolator
- No soil penetration
- Seismic protection
- Can negotiate variable grades
Site Design Techniques

Roof Investigation

Pre-Fab Units
- Configured for roof component
- Provide joints for fastening pv panels
Imperceptible from the ground. Maintain at least 2% slope over site for good drainage.

Some grading or adjustment via foundations needed.

Consider catching surface flow with swales, trenches, or drains.

Requires Grading (and probable excavation/exposure of soil).

Negotiate slope with terraces, ramps, and steps.

Extensive Grading necessary (and probable excavation/exposure of soil).

Negotiate slope with terraces, ramps, and steps.
Site Design Techniques
Steps and Ramps

Refer to the ADA Accessibility Guidelines for Buildings and Facilities for complete ramp requirements.

Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp. The least possible slope shall be used for any ramp. The maximum slope of a ramp shall be 1:12.

The maximum rise for any run shall be 30 in (760 mm).

The minimum clear width of a ramp shall be 36 in (915 mm).
Site Design Techniques
Circulation and Drainage

1. Groundwater recharge filtration strip
2. Stormwater detention
3. Connected tree pits (preferred)
4. Above-ground tree planters