



# Response to TEPCO'S Fukushima-Daiichi NPS Accident and Decontamination in Off-Limits Zones

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# Basic Principles and Setups in Responding to TEPCO's Fukushima-Daiichi NPP Accident

## Headquarters of Fukushima Partnership Operations

Chief of headquarters  
Atsuyuki Suzuki, President

Acting chief of headquarters  
Yoichi Ito, Executive Director

Basic principles in responding to Fukushima-Daiichi NPP accident:

- Responsibility as the one and only institution dedicated to the comprehensive research and development of nuclear energy-related technology in the country;
- Make full use of our human resource and research facilities with the Fukushima Engineering Headquarters being the command center, aiming at the greatest possible contribution; and
- Continue to be involved in the restoration effort from Fukushima-Daiichi NPP accident in a mid- and long-term perspective.

(Reorganized on Nov. 21 )

### Fukushima Environmental Safety Center

Junichiro Ishida, Director (168 Members)

Responsible for:

- (1) Liaison with provide support to related agencies in Fukushima region;
- (2) **Radiation monitoring and mapping;**
- (3) **Remedies for environmental damage;**
- (4) Radiation telemetry technique; and
- (5) Studies on radioactive substance's dynamics in environment, radiation dose analysis, etc.

### Department of Partnership Operations for Plant Restoration

Remote and Robotics Engineering Office (16 members)

Hirofumi Nakamura, Deputy Director

Responsible for:

- (1) Handling of damaged fuel;
- (2) Handling of built-up water; and
- (3) Technology for remotely-controlled robots, preparation of nuclear disaster responding robots.

### Department for Planning and Management of Partnership Operations

Takashi Iijima, Deputy director (12 Members)

Responsible for:

- (1) Summary of Fukushima responses;
- (2) Preparation of plans and schedules; and
- (3) Liaison with outside agencies including administrative organs.

Note: The numbers of respective departments are those of Jan. 6, including members holding multiple posts and temp staffs for commissioned work.



## Efforts toward Environmental Monitoring and Environmental Restoration

### (1) Environmental Monitoring

- Continuing monitoring of environmental radiation and soil radiation levels following the accident;
  - Preparation of detailed maps commissioned by the Ministry of Education, Culture, Sports, Science and Technology;
- Wide-area monitoring by aircraft

### (2) Efforts toward Environmental Restoration

- Decontamination (including its verification) of school's playgrounds, school zones, swimming pools, etc. Preparation and publication of decontamination manuals.
- Demonstration of decontamination techniques using polymeric scavengers and fixation agents. Waste incineration test.
- Demonstration tests of decontamination in Date-city and Minamisoma-city commissioned by the Cabinet Office.
- Demonstration of model-case decontamination in 12 municipalities including those in the off-limits zone sponsored by the Cabinet Office.
- Fulfill the responsibility as a member of the National Decontamination Project Team by sending experts upon request from the municipalities, responding to technical inquiries concerning the preparation of decontamination plans, etc.

### (3) Efforts toward the Diffusion of Decontamination-Related Knowledge

- Send lecturers and instructors for hands-on training in "decontamination work supervisor workshops" of Fukushima prefecture.
- Preparation of movie materials explaining the decontamination technique in layman's terms.

### (4) Public Relations Activities

- Hold "Q&A sessions concerning radiation" for parents, school teachers, etc.
- Conduct internal exposure monitoring for the citizens upon request from Fukushima prefecture.

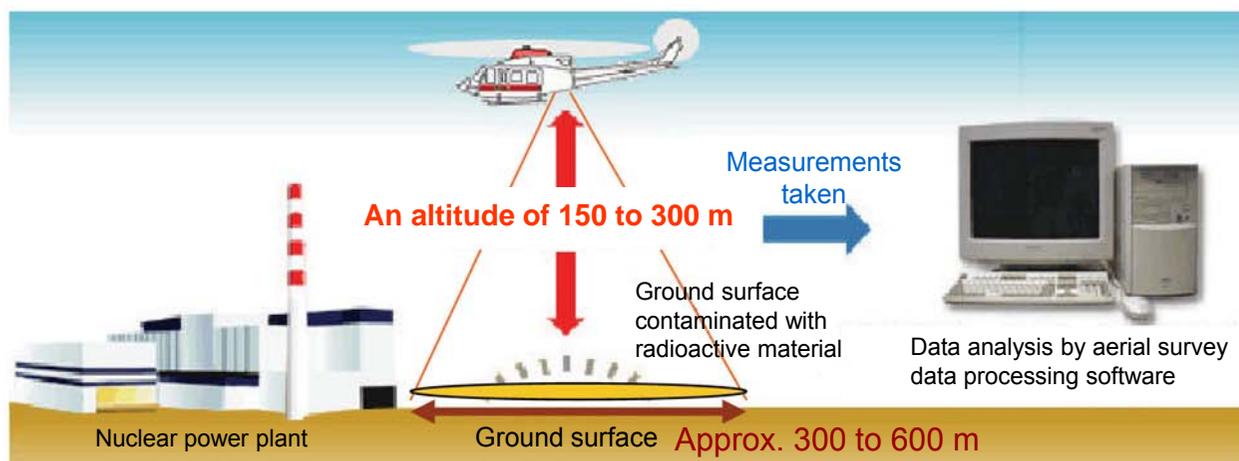
### Environmental restoration strategy is needed.

To make **effective** environmental restoration in the **least time** in a **rationalized manner**, environmental restoration strategies on a municipal level will be needed, which are based on environmental restoration strategies on a community level that takes individuals' living areas, natural conditions, etc. into consideration.

When conducting environmental restoration, it is necessary to anticipate the distribution and migration of radioactive substances in advance, and to examine what sort of results could be obtained with what sort of decontamination methods. Then, while listening to the wishes of the people in the community, we should use decontamination tools that are best fit for the situation in hand in accordance with the optimum priorities determined. Citizen's participation may be advisable as long as appropriate safety measures are ensured.

# Wide-Area Radiation Monitoring by Aircraft

- An aircraft (mostly a chopper) equipped with a highly sensitive radiation detector (NaI scintillation counter) and a NaI spectrometer flies over at an altitude of 150 to 300 m and **continuously takes measurements of gamma-ray radiation from the ground at a frequency of once a second.**
- Then, on the ground, from the measurements of the gamma-ray radiation taken aboard the aircraft, compute the air-dose rate of gamma-ray radiation at the height of 1 m above ground and the concentration of radioactive material on the ground surface, while taking the intensity attenuation due to the altitude into consideration.



(Aerial monitoring system)



## ● Gamma-ray counts in the air



Compute air dose-rates at the height of 1m above ground

- [1] Relationship between measurements taken on the ground (along the test lines) by a survey meter (air dose-rates) and the count rates taken in the air
- [2] Derive altitude correction functions along the test lines.

## ● Relationship between the air dose-rate and the radioactive concentration in the soil



Compute the concentration of Cesium-134

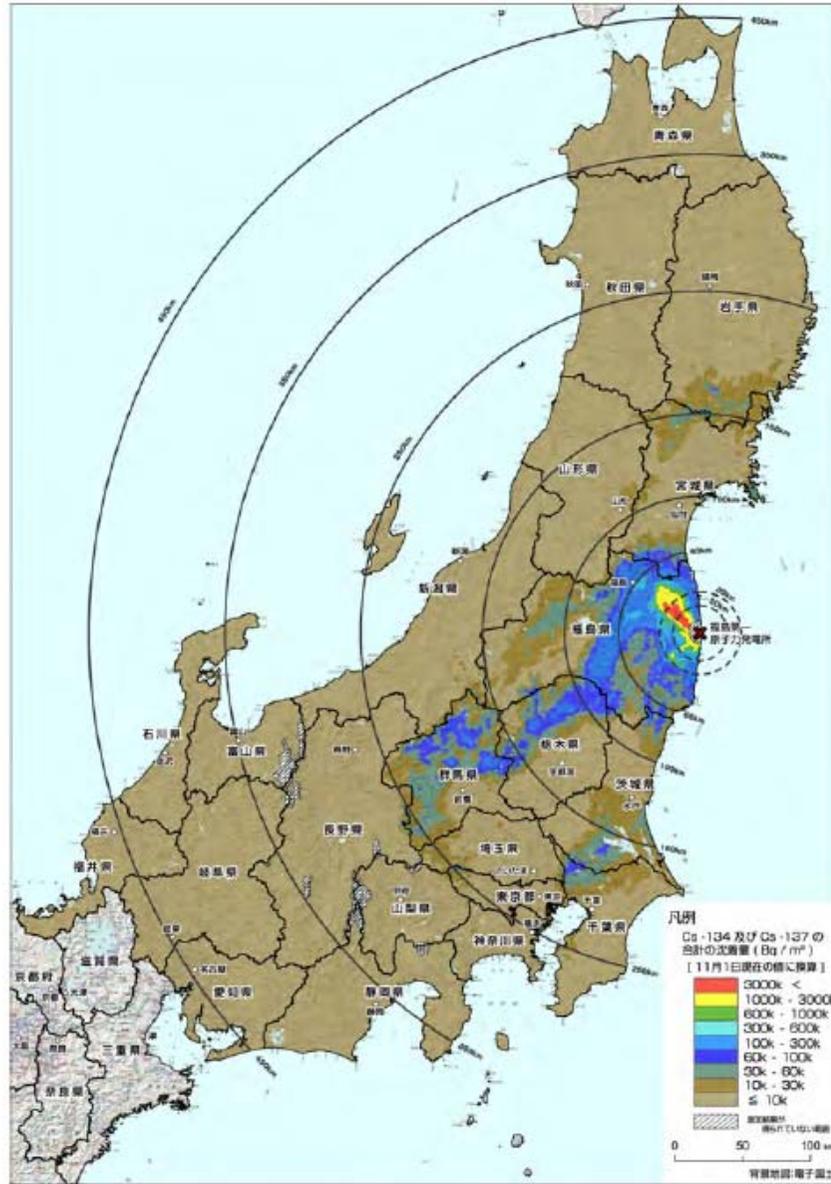
- [3] Concentration ratio of Cs-134 and Cs-137 by in-situ analysis on the ground



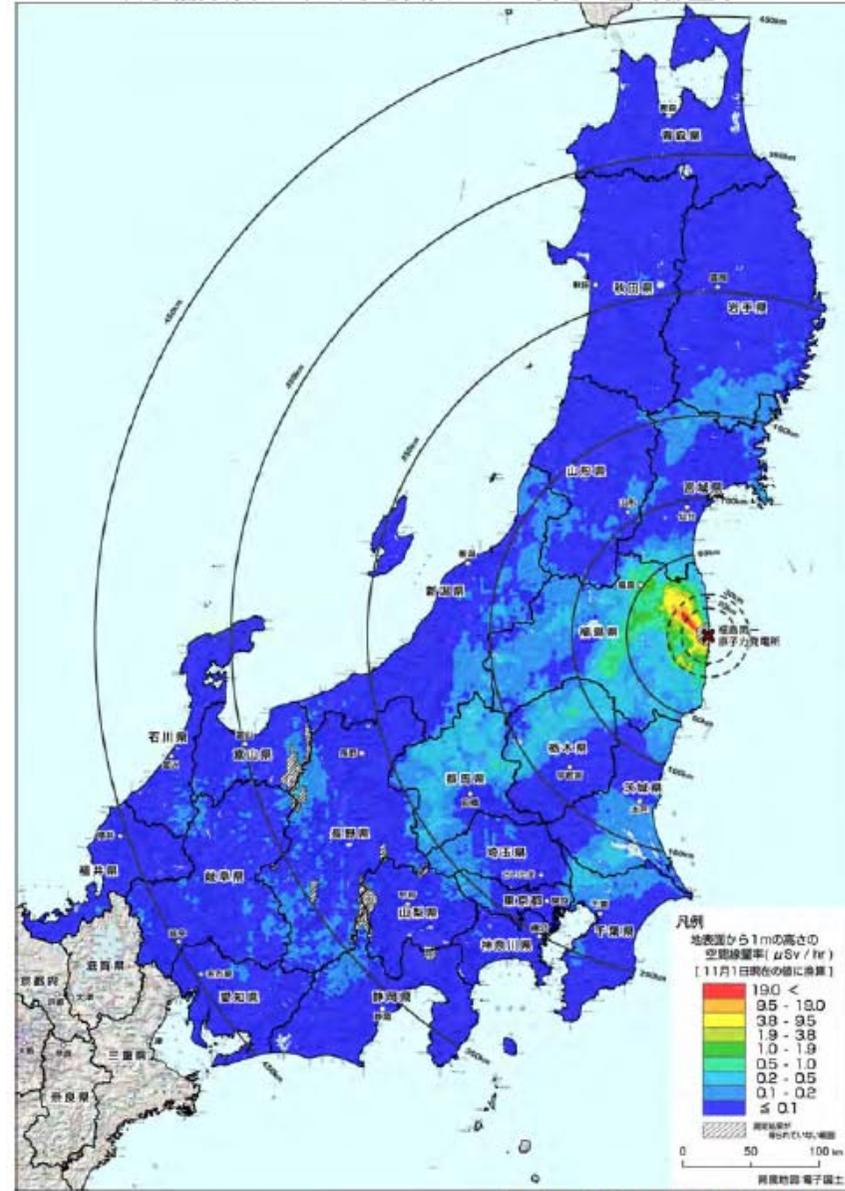
Compute the concentration of Cesium-137

# Result of Aerial Monitoring Centered at TEPCO's Fukushima-Daiichi NPP (Measurement taken by JAEA and NSTC)

Accumulation of Cs-134 and Cs-137 on land



Result of monitoring for radiation dose rate distribution



※本マップには天然核種による空間線量率が含まれています。

## Unmanned Helicopter System for Remote Radiation Monitoring



Able to take measurements of air dose rate at a height of 1 m above ground up to at an altitude of approx. 30 m.

<<Monitoring over farmland, woodland, etc.>>

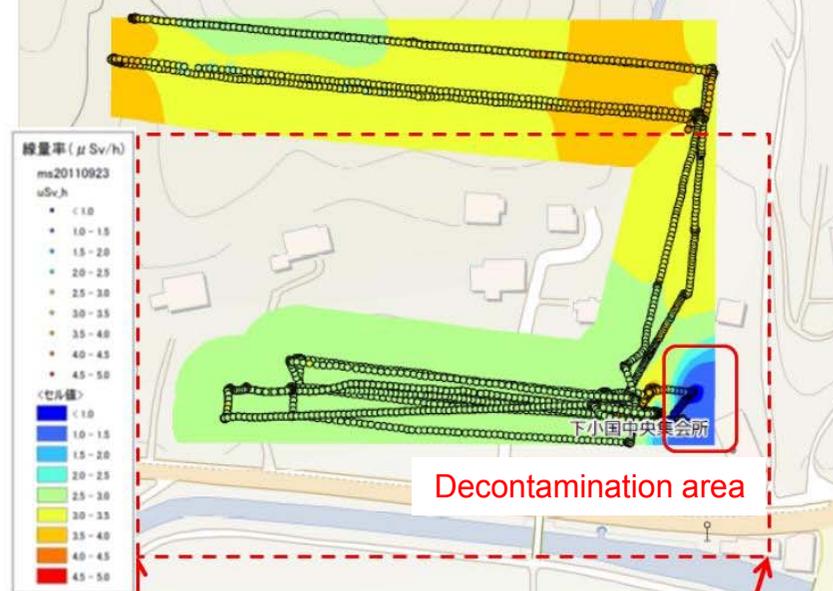


Monitoring over the shimo-oguni community house and its surrounding area in Date-city

Gamma-radiation from cesium



Result of the measurement over the Shimo-oguni community house and its surrounding area in Date-city





# Model-Case Decontamination Demonstration Project Commissioned by the Cabinet Office

## Soliciting ideas for model-case decontamination demonstration (decontamination demonstration in 12 municipalities)

Group	Adoptor	Municipalities
Group A	Taisei Consortium	Minamisoma-city, Kawamata-machi, Namie-machi, Iitate-mura
Group B	Kajima Consortium	Tamura-machi, Futaba-machi, Tomioka-machi, Katsurao-mura
Group C	Obayashi Consortium	Hirono-machi, Ookuma-machi, Naraha-machi, Kawauchi-mura

## Soliciting ideas for demonstration of decontamination technologies (select 25 entities)

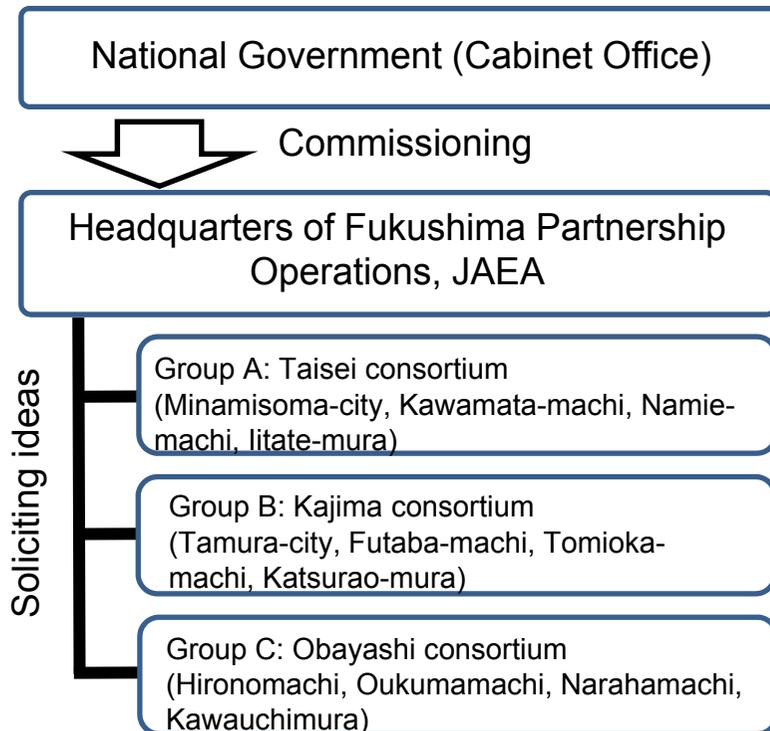
Entity	Themes for demonstration	Entity	Themes for demonstration	Entity	Themes for demonstration
JAXA	Volume reduction by thermophile aerobic bacteria	Takenaka Corporation	Multi-step washing of soil	Tokyo Institute of Technology	Purification by adsorbing/coagulating/precipitating agents compounded with iron ferrocyanide
Natures, Inc	Decontamination by mole-cluster ozone water	Koriyama Chip Industry Co., Ltd.	Decontamination and volume reduction by washing and incinerating wood and tree bark	Kitect Inc.	Decontamination by surface processing with ultra high-pressure water
Macoho, Co., Ltd.	Decontamination of road surface by wet-blasting	Toshiba Corporation	Technique to retrieve Cs from soil	Taisei Corporation	Surface decontamination for making woody waste into chips
Rohto Pharmaceutical, Co.,Ltd.	Volume reduction of radioactive material in soil	Kyoto University	Wash-off of Cs by nano-bubble water	Konoike Construction Co., Ltd.	Volume reduction by wet classification of soil and surface grinding
Sato Kogyo Co., Ltd.	Decontamination of soil; volume reduction	Obayashi Corporation	Increasing efficiency of decontamination of woodland, etc.	Hitachi Plant Technologies, Ltd.	Volume reduction by classification of soil and heat treatment
Taiheiyo Cement Corporation	Removal of Cs from soil	Kantechs Co., Ltd.	Decontamination of wreckage and debris by dry ice	Maeda Corporation	Decontamination of street gutters in the housing land by artificial zeolite blocks
Nippon Steel Engineering Co., Ltd.	Volume reduction of removed dirt, sludge, etc.	Mikuniya Corporation	Organic volume reduction system	Shiga Toso	Decontamination not by washing with high-pressure water; mitigation of contamination by hydrophilic coatings
Toda Corporation	Volume reduction by washing	Kumagai Gumi Co., Ltd.	Volume reduction by special washing equipment		
Neonite Corporation	Decontamination technique of woody biomass	Fukushima Prefectural Forestry Research Centre	Development of dose reduction technique for woodland		

# Project's Outline and Implementation Setups

## Project's Outline

For 12 municipalities in the off-limits zone and the scheduled evacuation zone, promote demonstrations of needed technologies so that effective decontamination can be conducted.

## Setup for the project

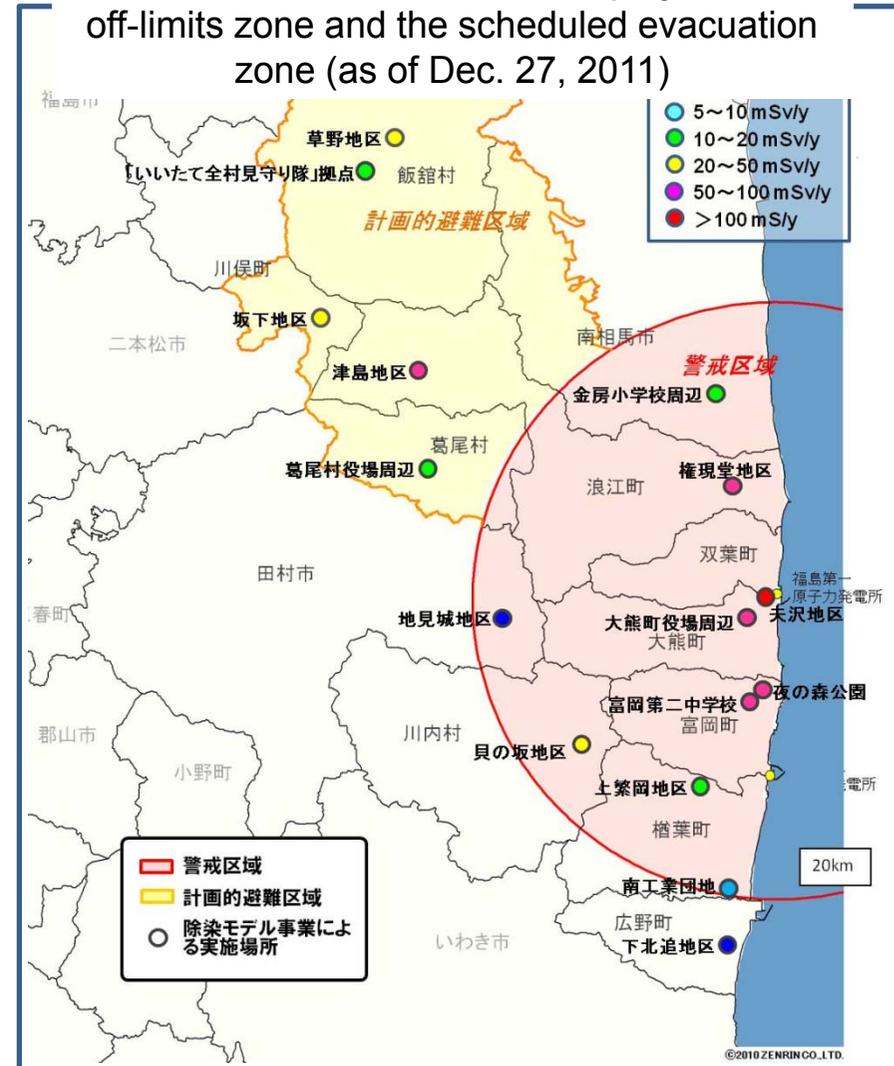


■ Each group should encompass the following.

▶Decontamination targets: woodland, farmland, housing land, structures, roads.

▶Dose rate classifications: high (> 100mSv/yr), intermediate (20 to 100mSv/yr), low (5 to 20 mSv/yr)

Targeted areas of the model-case decontamination demonstration project in the off-limits zone and the scheduled evacuation zone (as of Dec. 27, 2011)



双葉町については、町より除染モデル事業の実施は見送る旨、連絡あり。

## Details of Targeted Areas in Respective Municipalities for Decontamination

Group/Municipality		Targeted Areas for Model-Case Decontamination Demonstration Project	Areas To Be Decontaminated (Approx. 221 ha in total)	
			Principal Elements/Features	Area
Group A	Minamisoma-city	Kanabusa primary school's surrounding area	Farmland, structures (school), roads, woodland, housing land	Approx. 13 ha
	Kawamata-machi	Sakashita district	Woodland, farmland, roads, housing land	Approx. 11 ha
	Namie-machi	Tsushima district	Structures (high school etc.), woodland, housing land, roads	Approx. 21 ha
		Gongendo district	Structures (railroad tracks and stations, libraries, etc.), private houses, roads, farmland	
	Iitate-mura	Kusano district	Structures (workshops, nursing homes, etc.), farmland, private houses, housing land, woodland, roads	Approx. 29 ha
Bases for "Iitate-mura Watchers" etc.				
Group B	Tamura-city	Jikenjou district	Farmland, woodland, housing land, roads	Approx. 15 ha
	Katsurao-mura	City hall' surrounding area	Woodland, structures (school, city hall), housing land, roads	Approx. 6 ha
	Tomioka-machi	Yorunomori park	Structures (school, playground, etc.), housing land, woodland, roads (roadside cherry trees)	Approx. 12 ha
		Tomioka Daini Jr. Highschool		
Futaba-machi	-	-	-	
Group C	Hirono-machi	Shimokitaba district	Structures (city hall, schools, playground), housing land, roests, roads	Approx. 32 ha
	Ookuma-machi	City hall's surrounding area	Structures (city hall, community house, parks), housing land, roads	Approx. 6ha
		Ottozawa district	Farmland, woodland, housing land, roads	Approx. 13 ha
	Naraha-machi	Kamishigeoka district	Farmland, housing land, woodland, roads	Approx. 4 ha
		Southern Industrial Park	Structures (factories etc.), roads	Approx. 37 ha
Kawauchi-mura	Kainosaka district	Farmland, woodland, private houses, roads	Approx. 22 ha	

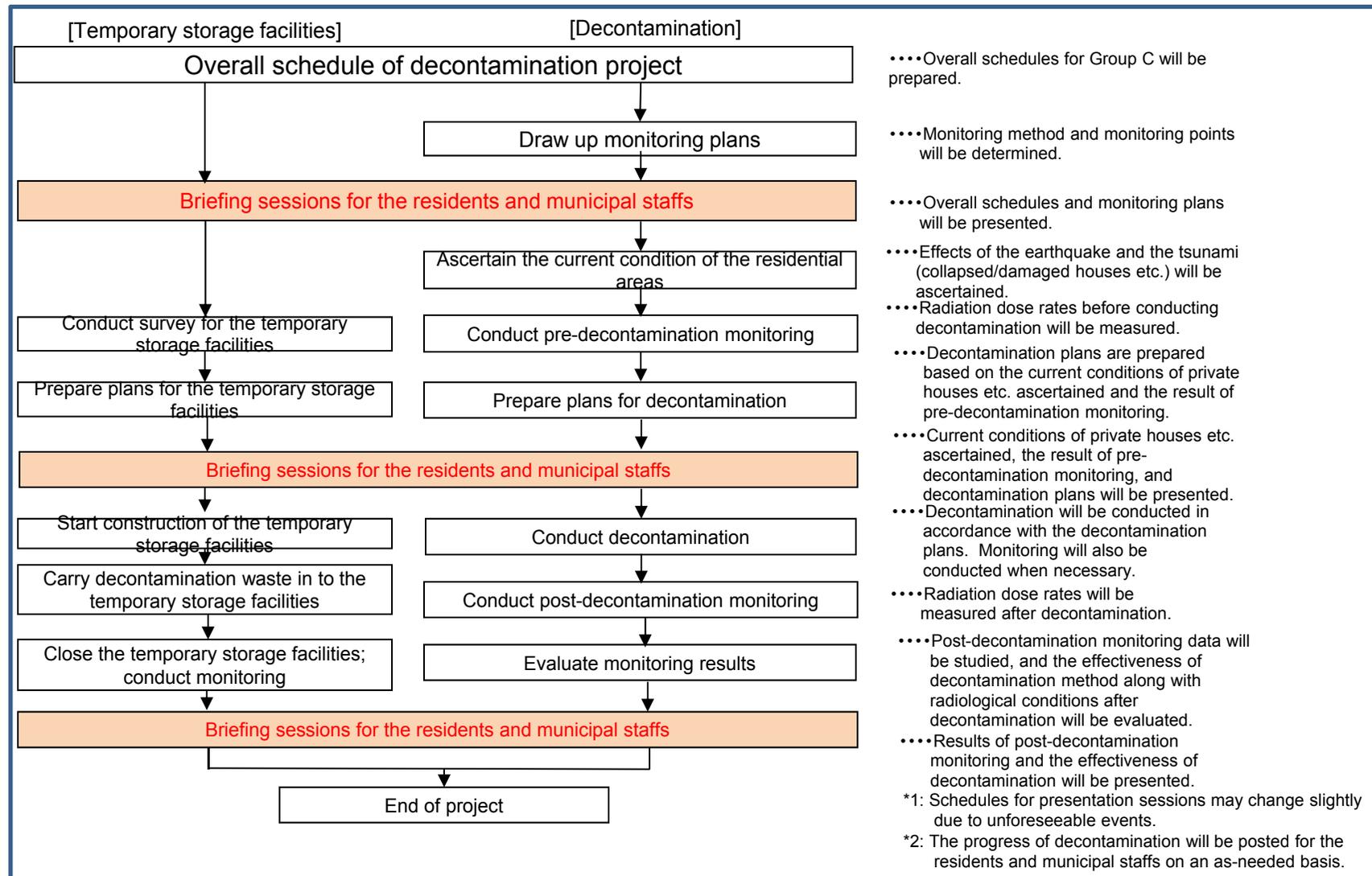
## How To Proceed

### Principal Actions

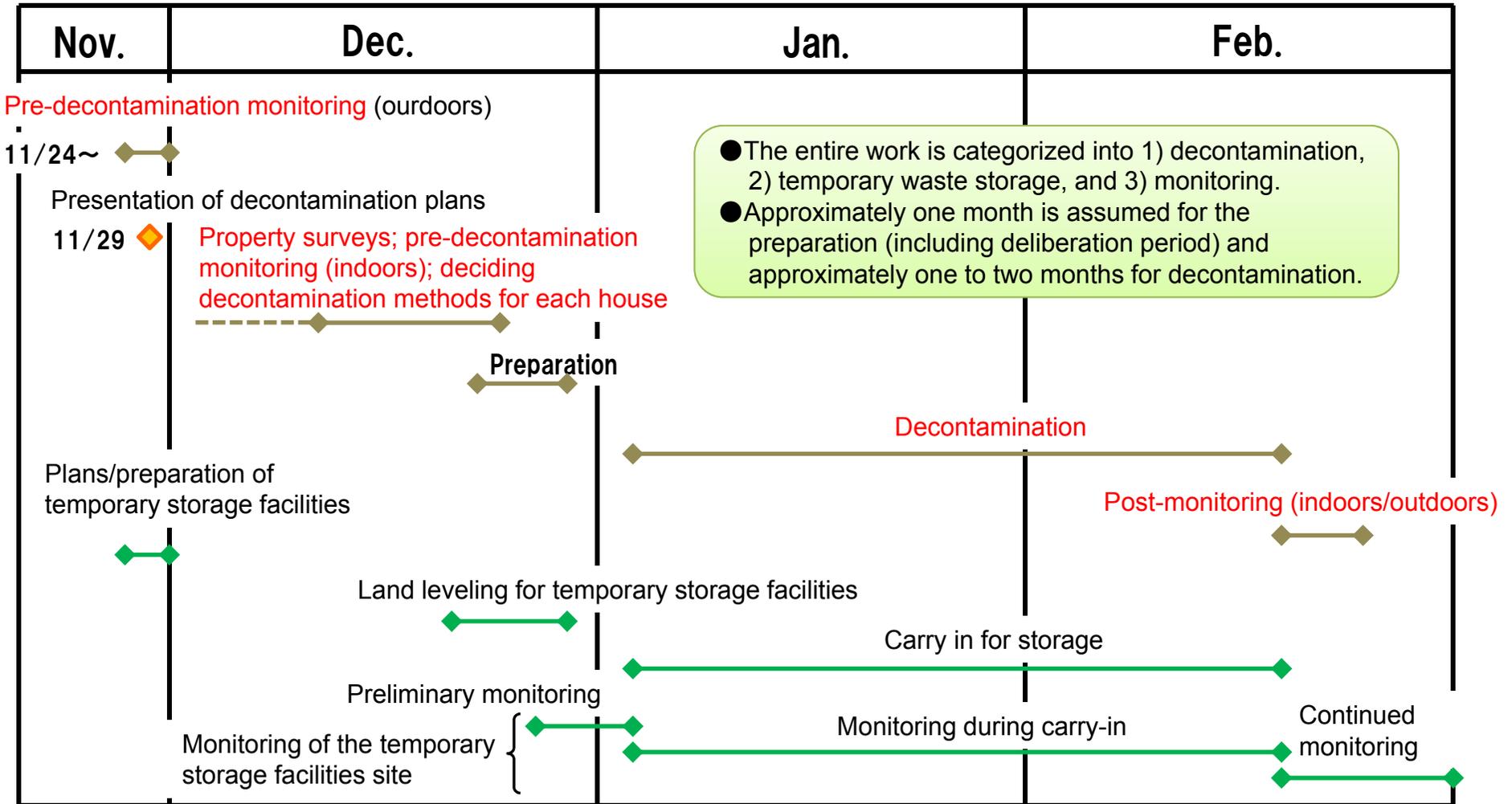
- **Verify that the dose rate can be reduced.**
- **Check the cost and effectiveness of decontamination technologies, including new ones, and the type and the volume of decontamination waste. Verify the effectiveness of the volume reduction technology. Record exposure doses of the workers and time needed for them to perform their work.**
- **Verify methods for conducting wide-area decontamination, high-dose rate-area decontamination, and decontamination of debris and wreckage produced by the earthquake and the tsunami.**
- **Confirm procedures for the radiological control and safety management.**
- **Verify the applicability of individual methods for soil isolation, decontamination water processing, incineration of waste, etc.**
- **Verify methods for safe temporary storage and monitoring.**
- **Promote cooperation among residents concerning decontamination.**

# How To Proceed

## Flow of Decontamination model demonstration works



# Schedule of Model-Case Decontamination Demonstration Project (Example)



# Examples of Decontamination Method --Decontamination of Housing Land and Structures (1)--



**Roof:** Wash off with hot water or high-pressure hot water.

Solar panels or a damaged portion of the **roof:** Wipe off with sponges with an enhanced cesium-adsorption property

**Balcony:** Wash off with hot water or high-pressure hot water

**Gutters:** Remove accumulations; wash off with hot water or high-pressure hot water

**Garden trees:** Trim or remove them.

**Garden soil:** Remove the surface. (Then, bring in earth from other places)

**Shed:** Wash off with hot water or high-pressure hot water

**Turf:** Remove it. (Then, bring in earth from other places)

**Concrete surface:** Wash off with hot water or high-pressure hot water.

**Gravels:** Comb out and wash off. (Then, bring in earth from other places)

**Interlocking bricks:**  
Electric planer / wash by high-pressure water



# Examples of Decontamination Method --Decontamination of Housing Land and Structures (2)--

## Wash-off with high-pressure water



Roofs of large structures



Walls of office structures



Provide a dam in the gutter to collect wash water.

- Roofs and walls will be washed with **high-pressure water** (approx. 1.5MPa).
- Evaluate the effectiveness of hot-water washers or rotating brushes in decontamination.
- **Collect** wash water as much as possible to be treated with zeolite to remove radioactivity.
- Provide a dam to collect wash water.
- Partially damaged roofs will be treated with sponges or packs to be mentioned later.



Hot-water washer

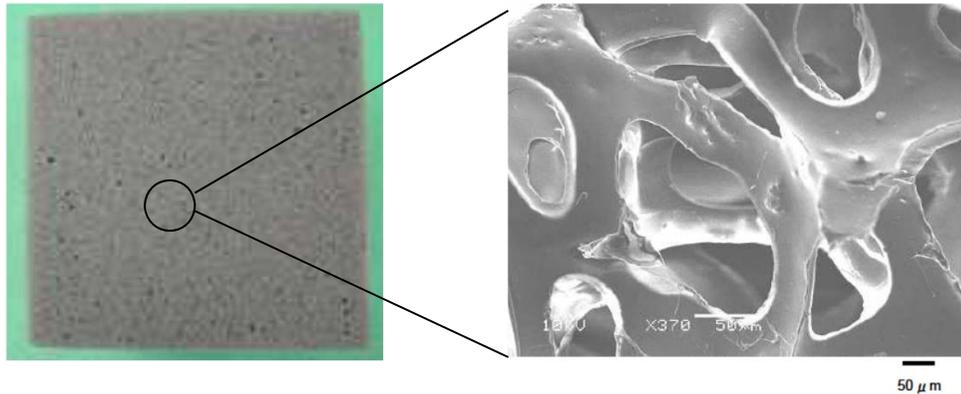


Rotating brush

## Examples of Decontamination Method --Decontamination of Housing Land and Structures (3)--

### Removal with sponges with an enhanced cesium-adsorption property (filters made of ferrocyanide compounds)

How to use (1): Use on damaged roofs, windows, areas with intricate shapes, etc. to wipe off.



#### ● Features

- Cesium is trapped in nano-cavities (ultra-small cavities).
- Cesium will not come out even if squeezing the sponge.
- Compared to paper towels, an amount of waste can be expected to be reduced.

Provide a dam to block cesium contained in the wash water.

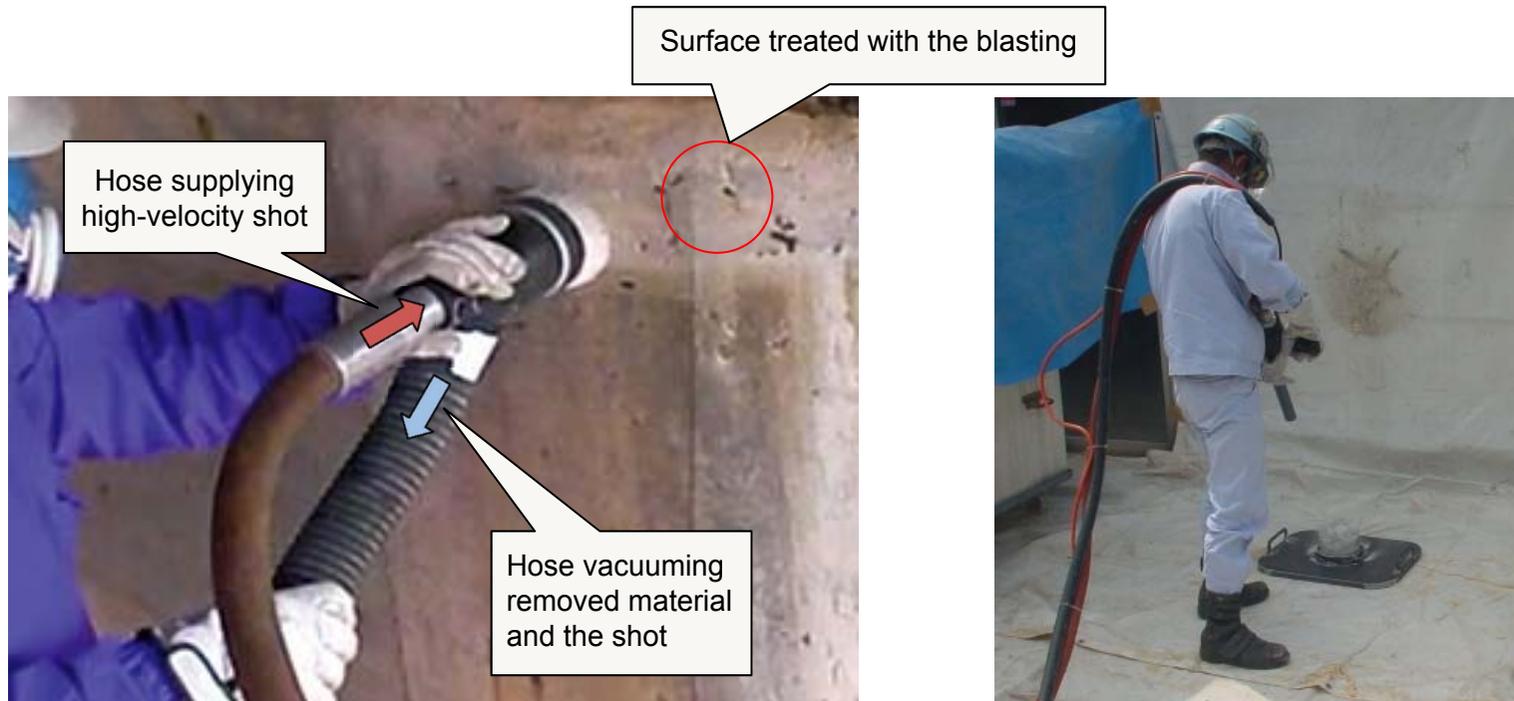
Dam made of the sponge

- Provide a dam made of the high-adsorption sponge and let wash water go through, allowing cesium to be adsorbed by the sponge, thereby purifying the passing water.



## Examples of Decontamination Method --Decontamination of Housing Land and Structures (4)--

### Shot-blasting, ice-blasting (effective on concrete surfaces etc.)



Shot-blasting

● **Features**

- Having the shot consisting of tiny iron balls of a few mm in size impact on the wall etc. to remove a thin layer of the material from the surface.
- The shot is collected and isolated by a magnet to be reused.

Ice-blasting

● **Features**

- Having the shot consisting of fine pellets of dry ice impact on the wall etc. to remove a thin layer of the material from the surface.
- The pellets need not be collected since they vaporize after impacting on the wall etc.

## Examples of Decontamination Method --Decontamination of Housing Land and Structures (5)--

### Removal of garden soil or dirt, sludge, etc. in the street and roof gutters



Lichen and fallen leaves accumulated in the roof gutters



Removal of dirt, sludge, etc. accumulated in the street gutters

- Lichen, dirt, etc. containing cesium tend to accumulate in roof gutters, their outlets, , and street gutters.  
→ First, roughly remove fallen leaves, dirt, lichen, etc., and then, thoroughly wash off with high-pressure water.
- For garden soil, first remove it either manually or by machine, and then, bring in new dirt or decontaminated dirt.

#### Colors of the titles of the photos

Removal of dirt etc. accumulated in the street gutters

Bringing in new dirt after removal

•••Photos taken at the site during this model-case decontamination demonstration project.

•••Photos taken at other sites (image photos)

# Examples of Decontamination Method --Decontamination of Housing Land and Structures (5)--

## Removal with peeling agents



### —Cement roof tiles —



### —Walls —

#### ● Features

- Effective on areas of intricate shapes or where use of water may not be advisable.
- Peeling agents (similar to laundry starch) are applied on tiles, walls, etc. by a brush.
- Make sure the peeling agents are dry before peeling (it will take 24 hours or so).

# Examples of Decontamination Method --Decontamination of Housing Land and Structures (7)--

## Park: Trimming/Removal of Surface Soil etc.



Trimming of planting



Trimming of high trees



Removal of surface soil near the base of a tree



Removal of surface layer: turf



High-pressure washing on the tree bark

- Trim planting or high trees in or around the park. Remove the leaves and branches along with the radioactive material attached thereto.
- Of the surface layer of the park premises, for the turf or area near the bases of trees, remove earth for the depth of 5 cm into the soil along with turf and lichen.
- Since, according to the pre-decontamination measurements, the radioactive concentration of the lichen is relatively high, remove the lichen on the tree bark by the high-pressure washing.

## Examples of Decontamination Method --Decontamination of Housing Land and Structures (8)--

Playground etc.: Lawn mowing, removal of surface soil



Lawn mowing



Removal of surface soil of the playground (primary school)



Removal of the turf

- Use lawn mowers.  
→ The reduction of air dose rate was not confirmed with lawn mowers. Therefore, from now on, backhoes equipped with nails on the bucket will be used to remove turf.
- Remove surface soil of the playground using heavy machines like motor graders.
- In the case where no structures are around to block wind, fine particles of dust may be blown up in the air. To prevent such occurrences, implement measures such as spraying water.

## Examples of Decontamination Method --Decontamination of Roads (Paved Surface) (1)--

High-pressure water washing, washer vehicles, function recovery vehicles



High-pressure water washing



Brush washing



Washing by a function recovery vehicle



Spin-jet washing

- For the decontamination of (paved) roads, the effectiveness of decontamination is being verified with high-pressure water washing, brush washing, etc.
- Because of the need to smoothly collect wash water, washing with spin-jet devices or function recovery vehicles is also being conducted.
  - Spin-jet: Very high-pressure water is made to enter every aperture present on the paved surface. Drainage can be simultaneously collected.
  - Function recovery vehicles: Separate and remove dirt etc. by high-pressure washing and cavitation, and then, collect it by blowers and vacuum suctioning units.

# Examples of Decontamination Method --Decontamination Roads (Paved Surface; Gutters) (2)--

## Cutting of paved surfaces and high-pressure washing of gutters



Cutting by a TS cutting machine



Surface cutting by shot-blasting

— Cutting of the paved surfaces —

- Cutting a few mm of the paved surface using a **TS cutting machine**.
- After cutting, overlays of dense granular compressed concrete will be provided.
- If large cutting machines cannot enter, surface cutting by **shot-blasting** etc. will be conducted.
- At any rate, radioactive material that cannot be washed off with water can be removed.

- Insert the nozzle for the **high-pressure washing** into the gutter. Then, slowly draw the nozzle out while washing the gutter.
- Since lids to the gutter need not be removed, work efficiency is high, and the amount of dirt scattering around can be reduced.



Washer vehicles



High-pressure washing

— High-pressure washing of gutters —

# Examples of Decontamination Method --Decontamination of **Woodland**--

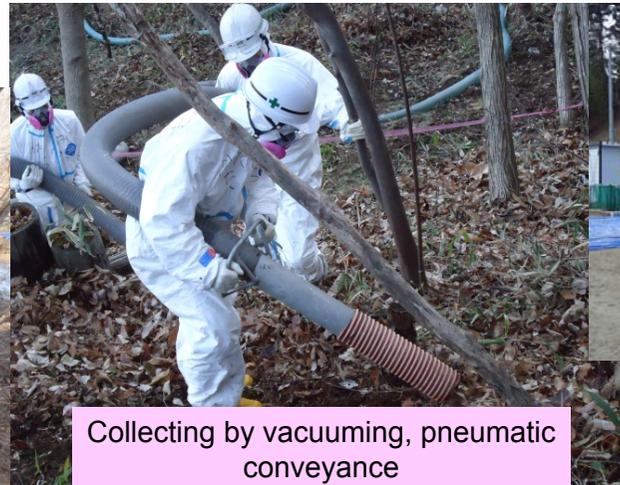
Undergrowth mowing, pruning, removal of fallen leaves, etc.



Defining boundaries for undergrowth mowing



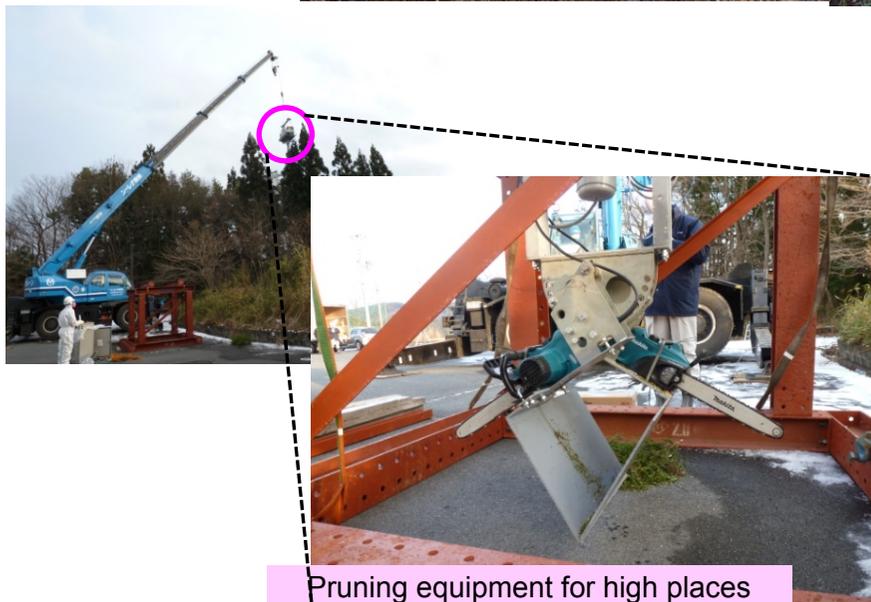
Undergrowth mowing, removal of the humus layer, etc.



Collecting by vacuuming, pneumatic conveyance



Vacuum suction vehicles



Pruning equipment for high places

- Decontamination of woodland **should start from the location close to the living environment. Methods and the extent of decontamination should be determined while checking on the effectiveness of the decontamination.**
- Conduct undergrowth mowing, humus layer removal, pruning, tree felling, etc.
  - For high trees, pruning equipment for high places will be introduced experimentally.
- Removed undergrowth, fallen leaves, boughs and twigs, etc. will be collected by a vacuum suction vehicle, using pneumatic conveyance efficiently.
  - Fallen leaves and dirt of the surface layer contaminated with radioactive material can be prevented from being spread out into the air, which is beneficial from the standpoint of radiological protection for workers.

# Examples of Decontamination Method --Decontamination of Farmland (1)--

## Removal of surface layer soil



### ● Remove surface layer soil

- After lightly crushing clods of earth in the surface layer (to the depth of 4 to 5 cm), remove surface layer soil with heavy machinery such as shoveling equipment.
- After removing grass, cutting roots, and loosening earth in the surface layer with a mowing machine, remove surface layer soil with heavy machinery (photos below left and right).
- In this manner, **grass** and surface **layer soil can be removed** efficiently.
- Furthermore, the thickness of the surface layer to be removed can be set by the centimeter, the amount of waste can be reduced.



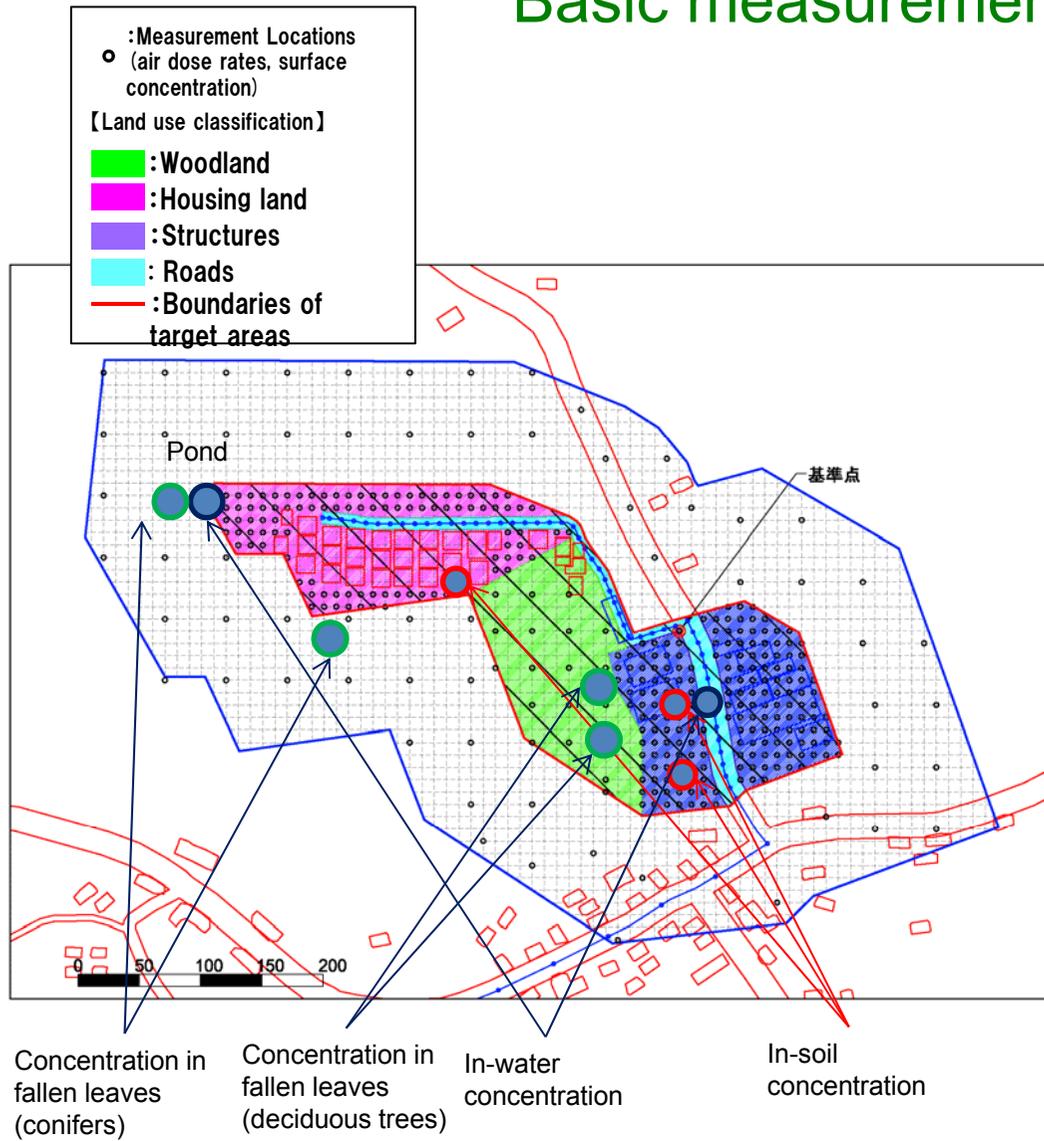
### Spraying soil fixation agents, peeling



#### ● Features

- Spray fixation agents, and then peel off the surface layer soil.
- By using fixation agents, the thickness of the surface layer to be peeled off can be controlled, which is beneficial to the **reduction of the amount of waste**.
- To ensure the safe and healthy fecundity of the farmland, fixation agents of the magnesium family will be used.

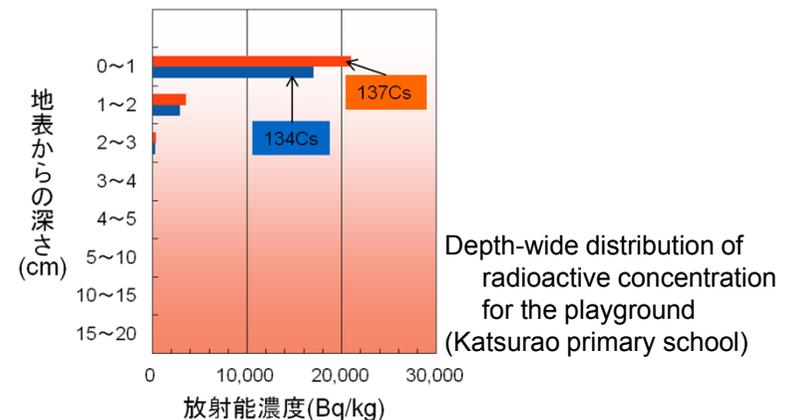
## Basic measurement



— Monitoring locations (Katsurao-mura) —

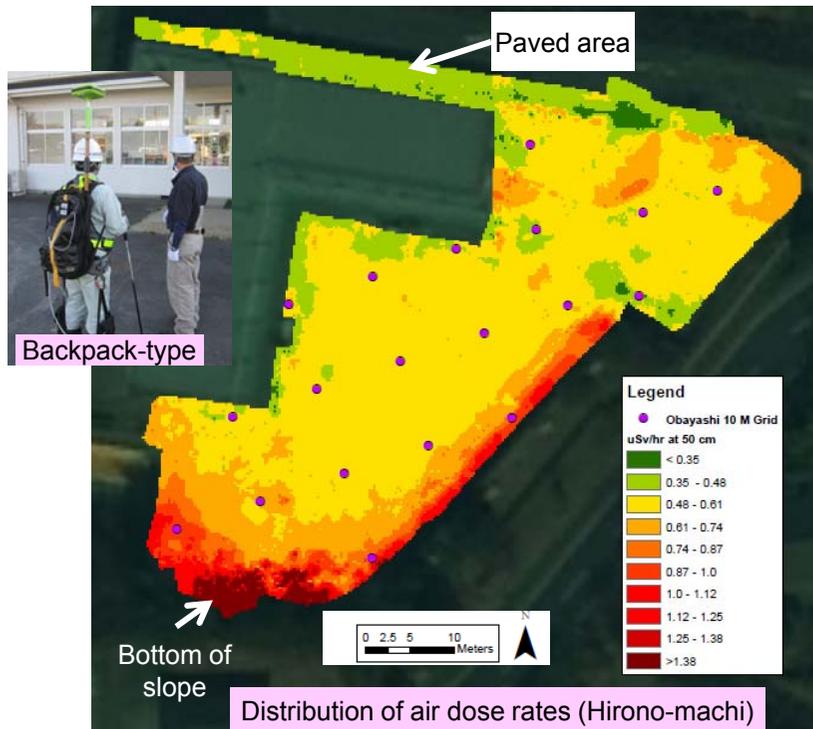
### ● Grid measurement

- Basically, a **10m** grid for areas to be decontaminated and a **50m** grid for areas outside of the decontamination areas will be applied. Take measurements on the air dose rates and the surface concentration.
- Measurements at the **hot spots etc.**
- Take measurements, if necessary, at locations where relatively high levels of radioactive concentration are expected such as near tree bases, under roof gutters, inside street gutters, etc.
- Take measurements, if necessary, on radioactive concentration for river and pond water, soil, fallen leaves, etc.
- Obtain **distribution of radioactive concentration** on earth surfaces etc.
- For the earth surface of playgrounds, obtain the **depth distribution** of radioactive concentration so that the thickness of the surface layer soil to be removed can be determined.



# Examples of Effort of Conducting Monitoring and Radioactivity Measurement (2)

## Trial technique



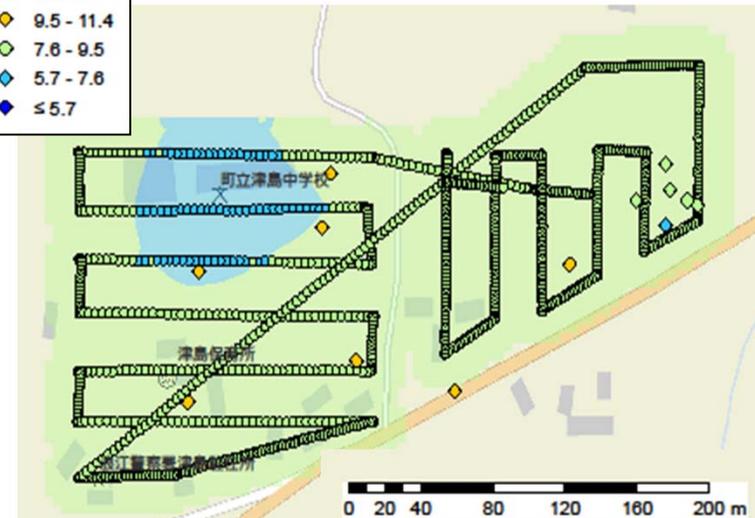
### — Scan plot —

#### ● Features

- The measuring device and the GPS unit are linked so that both air dose rates and positions are automatically measured and recorded at intervals of one second (used in the U.S. before).
- Mounted in a backpack or on a buggy vehicle.
- Radioactive distribution can be obtained efficiently.

凡例 (単位:  $\mu$  Sv/h)

線量率	地上サーベイ
11.4 <	11.4 <
9.5 - 11.4	9.5 - 11.4
7.6 - 9.5	7.6 - 9.5
5.7 - 7.6	5.7 - 7.6
$\leq 5.7$	$\leq 5.7$



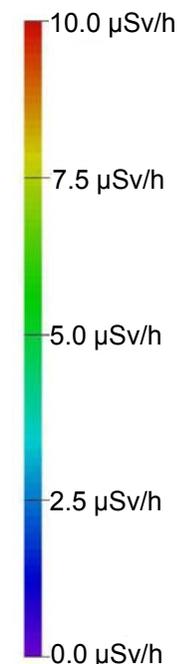
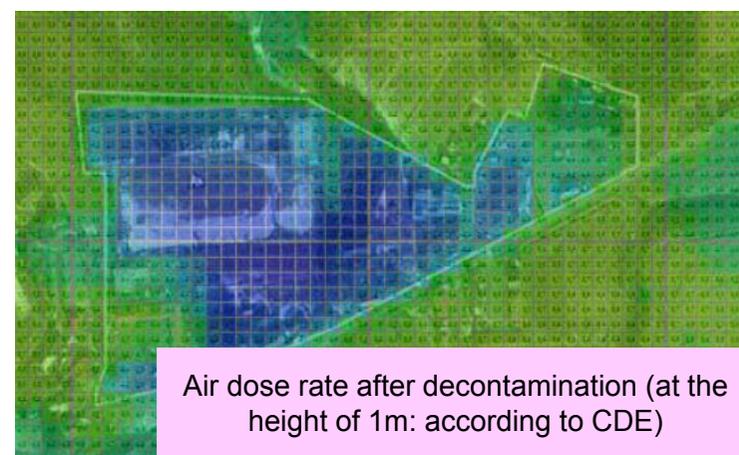
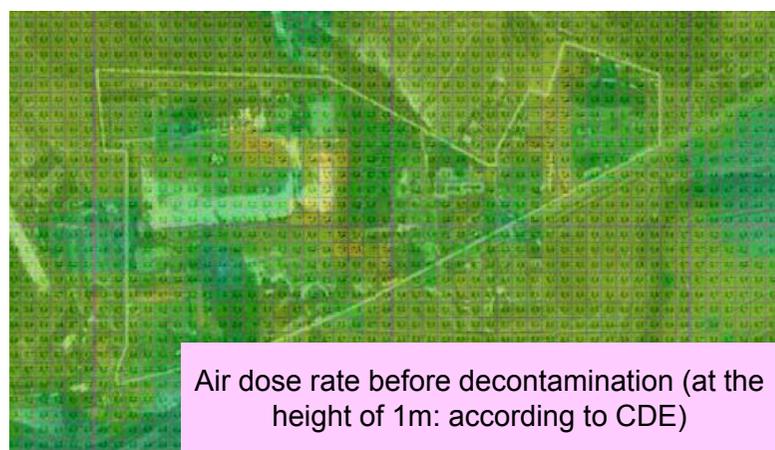
— Air dose rate distribution obtained by an **unmanned helicopter** (before decontamination of Tsushima district in Namie-machi) —

#### ● Features

- Air dose rates can be measured quickly (it takes about 40 minutes for Tsushima district)
- Sampling interval of one measurement per second; altitude of 20 to 80m
- Air dose rates can be measured for an area of a 20 to 50m radius (proportional to the altitude; therefore, if dose rates change significantly over a short distance, then the air dose rate measurements may not conform to the surface data.)

# Examples of Forecasts and Evaluation of the Effect of Decontamination

## Forecasts of the reduction factor of air dose rate



—Forecasts for the reduction factor of air dose rates according to CDE (Calculation System for Decontamination Effect) (a case of Tsushima district of Namiemachi)—

### ● Flow of the analysis

Input data (data concerning the surface condition)

- Surface contamination density on soil, paved roads, etc.
- Land use classifications of farmland, housing land, etc.
- Decontamination factors for each land use classification



Output data (data for 1m above ground)

- Air dose rates at the height of 1m above ground
- Forecast practical decontamination effect with due consideration for the reflecting effect from the air and the ground

### ● What's CDE?

- It provides approximations of the reflecting effect of radiation due to the air and the ground, which must be taken into account when evaluating the air dose rate.
- Accuracy may be compromised for greatly undulating topology or where there are many hot spots.

## Summary of **On-Site Storage/Temporary Storage** Method —Transport/Temporary Storage of the Waste—

### Flexible container bags



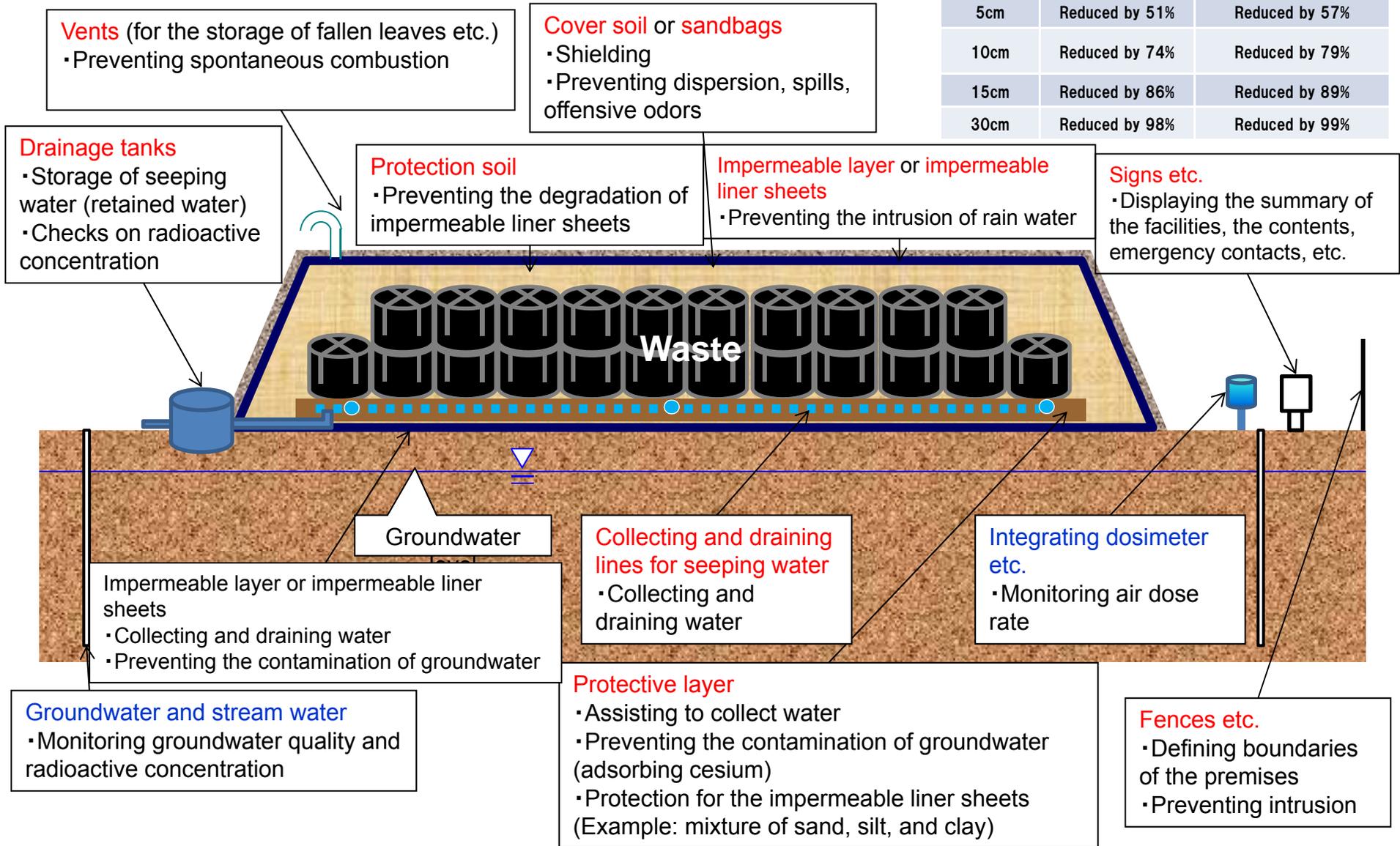
Metal tag (example)

#### ● **Features**

- Contains the waste. Prevents the dispersion of the contents while in transportation or temporary storage.
- Made of weather resistant materials.
- Available in a general market.
- In view of traceability, **metal tags** or **IC tags** holding information concerning dates, locations, contents, etc. will be attached.

# Examples of Temporary Storage Facilities — Safety Measures of Temporary Storage Facilities—

Thickness (cm)	Shielding by cover soil	Shielding by concrete
5cm	Reduced by 51%	Reduced by 57%
10cm	Reduced by 74%	Reduced by 79%
15cm	Reduced by 86%	Reduced by 89%
30cm	Reduced by 98%	Reduced by 99%



## Examples of Waste Volume Reduction —Treatment of Water Used in Decontamination—

In the case where radioactive concentration is **low**:

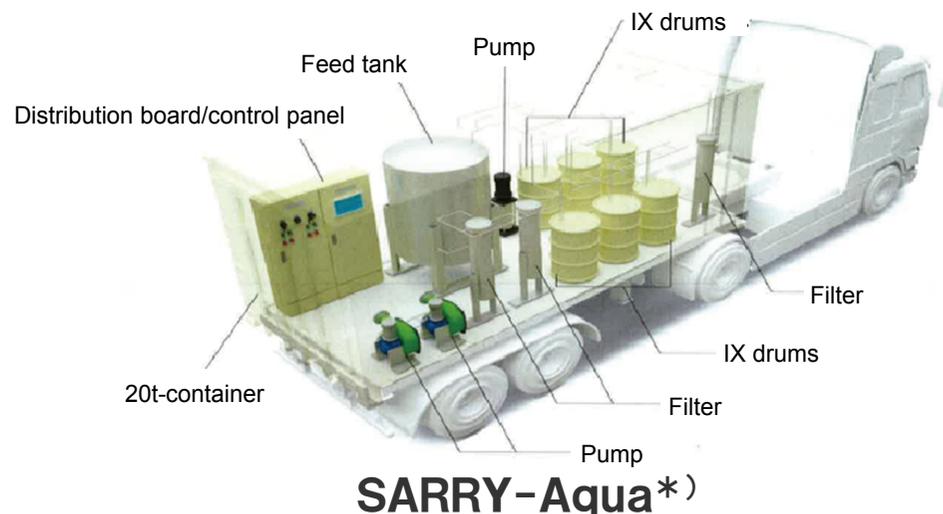


Column-type water treatment equipment

### ●Features

- It consists of columns filled with **activated carbon**, which captures suspended material, and other columns filled with **zeolite**, which adsorbs and removes cesium.

In the case where radioactive concentration is **high**:



**SARRY-Aqua**\*)

\*)Mobile version of the water treatment equipment (SARRY) at Fukushima-Daiichi NPP.

### ●Features

- Mobile equipment, which uses **high-performance zeolite-series resin** and can be used to process highly contaminated water.

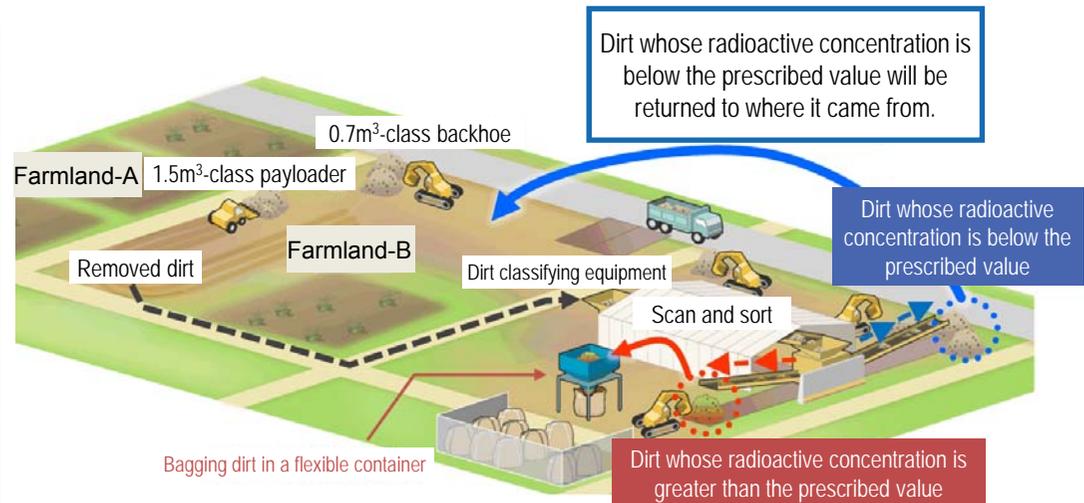
Processed water will be reused for washing or discharged (prescribed levels (e.g.) Cs134: 60Bq/kg, Cs137: 90Bq/kg)

# Examples of Waste Volume Reduction —Volume Reduction of **Plants and Soil**—



— Volume reduction of plants by **grinding** —

- By **grinding** plants, it is possible to reduce volume of voids that would otherwise be present inside the flexible bag etc.
- Example for this district: The volume of approximately 27.4m<sup>3</sup> was reduced to 3.8m<sup>3</sup>



## Radioactively contaminated dirt sorting system (**scan and sort**)

— Volume reduction for soil —

### ● Features

- Soil taken out of the surface layer of farmland is subjected for radioactive material concentration measurement while moving on a conveyor for inspection and classified according to the measurements.
- **Soil whose radioactive concentration is below the prescribed value** is returned to where it came from.

# Examples of Effort at Ensuring Safety of the Workers

Equipped with flaps to ward off the intrusion of foreign matter through zippers.

Rubber bands on the sleeves and the ankles to provide tightness.

Rubber bands around the waist to provide tightness.

Goggles to protect eyes from shattered objects

Respirators capable of blocking 99.9% of incident particles are used.

Rubber gloves over cotton gloves

High boots to be put on exclusively on-site

Workers carry both a pocket dosimeter and a glass badge.

— Examples of Tyvek suite worn by a worker —

Dust sampling at the site

Rest house

Screening spot of the rest house

- From the standpoint of **radiological protection** for workers engaged in the decontamination project, safety measures have been implemented.
- **Labor health issues**  
 A rest house is provided to each decontamination sector.
  - A single work cycle consists of 1.5 to 2 hours of work and a 30min-break.
  - Undressing tyvek suites and screening before entering the rest house.

## Examples of Group C: Ookumamachi City Hall and the Surrounding Area

### Ookumamachi (Ookumamachi city hall and the surrounding area)

○Area to be decontaminated: Approx. 4.5 ha

○Private houses: Approx. 30

○Public facilities: Ookumamachi city hall, Ookumamachi community house, park (approx. 1.2 ha)

○No farmland. A grove in the park



# Result of Pre-Decontamination Monitoring Around Ookumamachi City Hall (1)

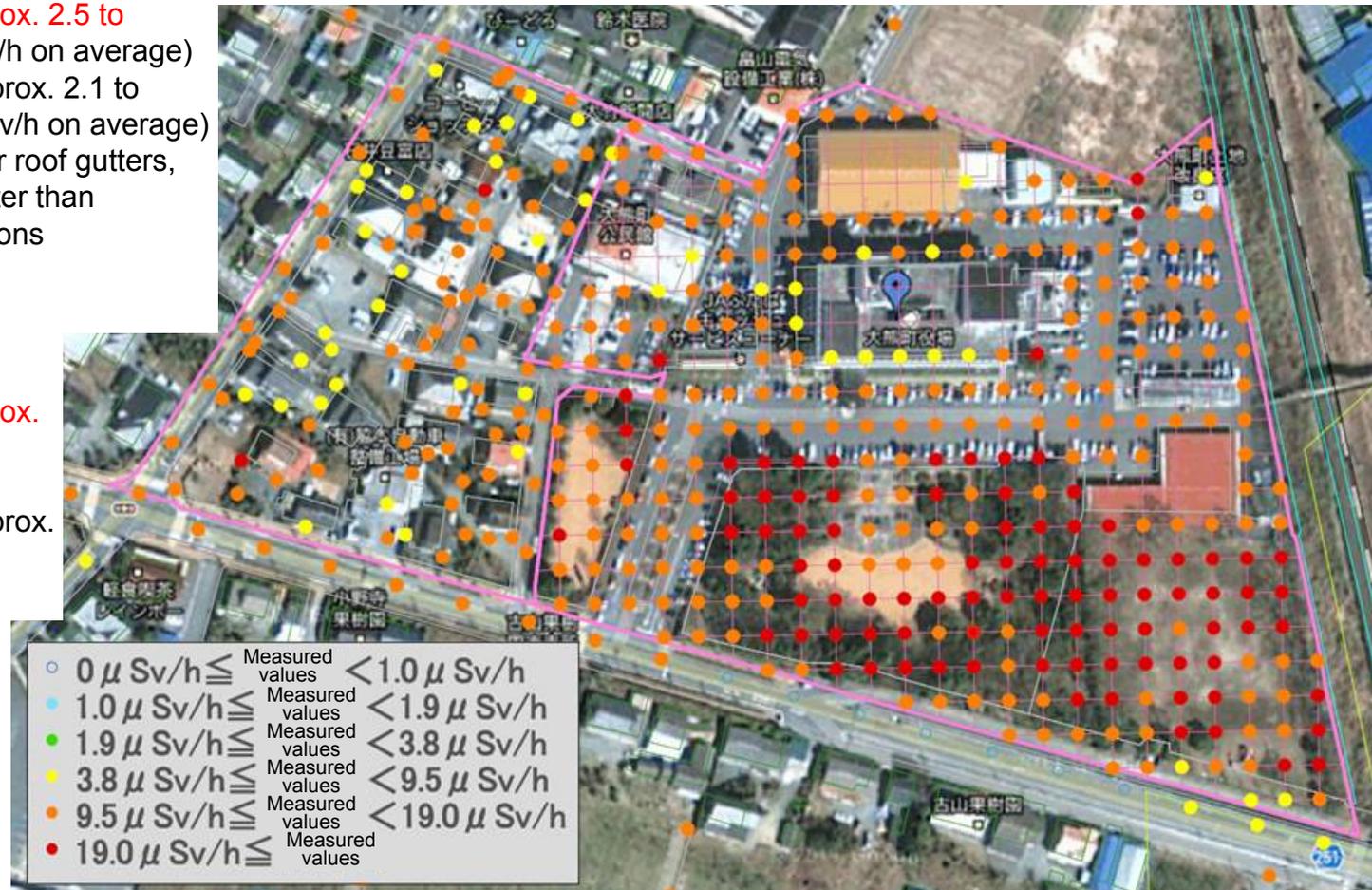
## Measurement of the air/surface dose rates

**Outdoor** (Approx. 550 points)

- 1m above ground: **approx. 2.5 to 40 $\mu$ Sv/h** (approx. 13 $\mu$ Sv/h on average)
- 1cm above ground: approx. 2.1 to 210 $\mu$ Sv/h (approx. 28 $\mu$ Sv/h on average)
- 1cm above ground near roof gutters, street gutters, etc.: greater than 100 $\mu$ Sv/h at some locations

**Indoor** (2 houses)

- 1m above ground: **approx. 1.9 to 8.5 $\mu$ Sv/h** (approx. 4.9 $\mu$ Sv/h on average)
- 1cm above ground: approx. 2.1 to 9.1 $\mu$ Sv/h (approx. 5.3 $\mu$ Sv/h on average)

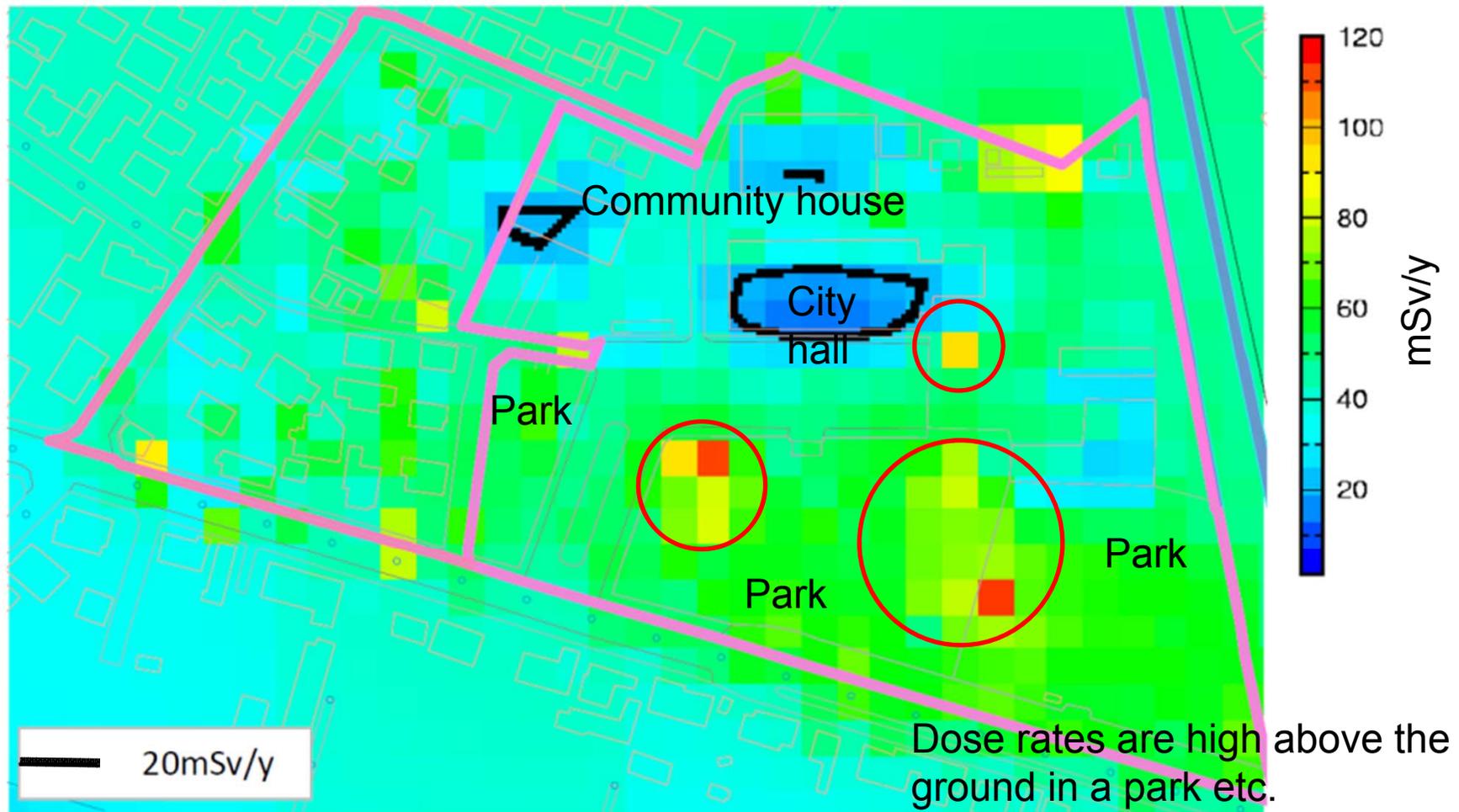


Outdoor radiological dose rates around Ookumamachi city hall

## Result of Pre-Decontamination Monitoring Around Ookumamachi City Hall (2)

Air dose rate map

○:Dose rates are high under trees.



# Current Status of Decontamination around Ookumamachi City Hall (1)

## Decontamination

- Started on November 28
- Decontamination conducted on the roofs of the city hall, housing land, parks, parking lots, etc.

### ● Roofs of the city hall

- Washing with high-pressure water/wire brushes.



Washing with high-pressure water

Scrubbing with wire brushes

— Roofs of the city hall —

### ● Housing land

- Washing roofs, gutters, trimming garden plants, and removing grass.

### ● Parks

- Removing fallen leaves from trees, and lichen.
- Removing surface layer dirt of the playground.



Removal of fallen leaves and lichen



Trimming garden plants.  
Removing grass

— Housing land —



Removal of surface layer dirt

— Park: Dirt area of the park —



Vacuum suction

— Park: Planted area —



Gathering and storing in a flexible container

Vacuum fallen leaves etc. and store them directly into a flexible container.

## Current Status of Decontamination around Ookumamachi City Hall (2)

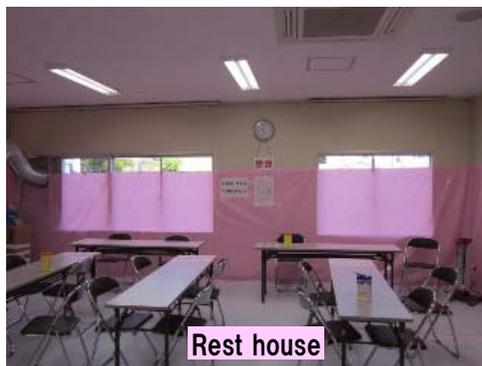
### Decontamination

(continued from previous slide)

- **Parking lots, roads** (asphaltic pavement)
  - Sand-blasting, dry ice-blasting, soda-blasting
  - Cutting pavements by TS scrapers (a few to 5 mm into the surface layer), water-jet, shot-blasting



— Parking lots, roads —



### ● Decontamination water purification system

- Decontamination water produced in high-pressure washing etc. and containing radioactive material is collected in a tank, purified by radioactive material filtering equipment, and reused as wash water.
- Measurement on the concentration of radioactive cesium before and after the purification (examples)
  - Decontamination water: 15kBq/kg
  - Purified water: <1.2kBq/kg

### ● Establishing a rest house

- A rest house is established in the community house inside the decontamination area.
- Dressing/undressing area and survey area are separated. Positive pressure is maintained to prevent the intrusion of dust and particles. Air-conditioned. Workers can take off their masks and eat meals.
- Clothing, hair, etc. are screened before entering the rest house.
- The air dose rate inside the rest house is approx. 1 $\mu$ Sv/h.

## Examples of Group A: Kawamatamachi, Sakashita district

### Kawamata-machi (Sakashita district)

- Area to be decontaminated: Approx. 11 ha
- Consisting mainly of **farmland** and **woodland** (approx. 8.5 ha)
- Private houses: approx. 10
- Public facilities: none



# Result of Pre-Decontamination Monitoring in Sakashita District, Kawamatamachi

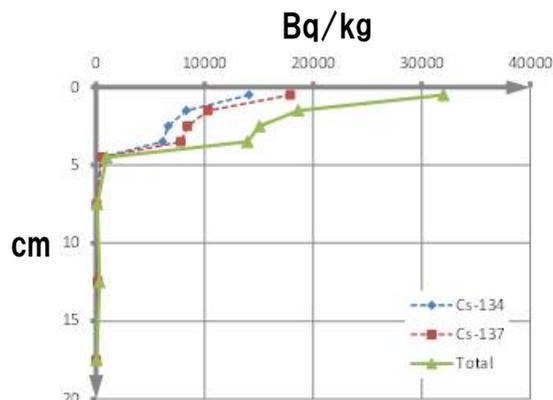
## Measurement of the air/surface dose rates

### Outdoor (Approx. 170 points)

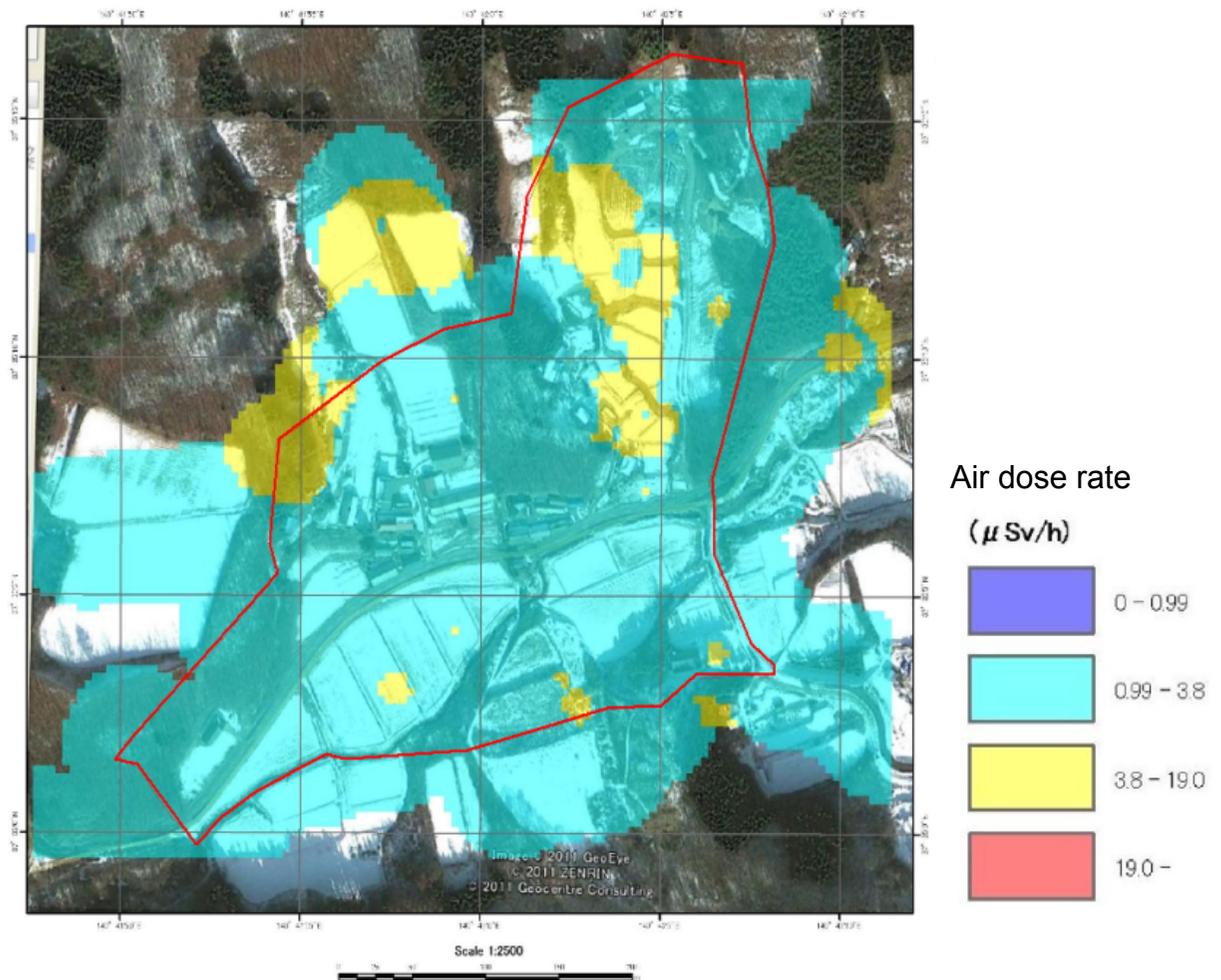
- 1m above ground: approx. **1.2 to 4.7 $\mu$ Sv/h** (approx. 3.9 $\mu$ Sv/h on average)
- 1cm above ground: approx. 1.2 to 9.8 $\mu$ Sv/h (approx. 3.2 $\mu$ Sv/h on average)
- The air dose rate is high above the south and north woodlands and the north farmland (3.5 ~ 4.5 $\mu$ Sv/h). The air dose rate is relatively low above the paved roads, the housing land, and the south farmland. (1.5 ~ 3.0 $\mu$ Sv/h)

### Environmental data

- Soil: Radioactive concentration is high for the depth of **approx. 5cm from the surface**.
- Radioactive concentration of water is almost below the detection limit (1.0Ba/kg).



Depth distribution of the radioactive concentration in the soil



Outdoor radiation dose rates in Sakashita district in Kawamata-machi

# Current Status of Decontamination etc. in Sakashita district in Kawamatamachi

## Decontamination

- Started on December 7
- Woodland, farmland, and housing land have been decontaminated.

### ● Woodland

Undergrowth mowing and removal of fallen leaves. The removal included the litter layer .

### ● Farmland

▪ Undergrowth mowing; removal of surface soil; applying fixation agents and removing thin layer of soil.

### ● Housing land

- Brushing or scrubbing on the walls
- Removal of deposited material in the roof gutters



— Farmland —

※ Litter layer: A layer of deposited material, consisting of fallen leaves, boughs and twigs, etc., that has been left as it is and hardly been decomposed yet by soil organisms.

# Conclusion

- ▪ Continue to take measurements of environmental radiation and radioactivity in the soil etc. (including the aerial monitoring)
- ▪ To prepare for full-scale decontamination, carry out step by step the projects commissioned by the National Government such as the decontamination demonstration project.
- ▪ Provide training to the personnel so that they can be instrumental in supporting people with the knowledge about decontamination or in the decontamination work itself



- Make possible to return home at the earliest possible time.
- Reduce the exposure dose.