Effluent management
Site and environmental monitoring

AUBE Disposal Centre – CSA

S. DINANT

Monitoring objectives for the Centre and its environment

- **Verify** compliance with regulatory requirements
  (*Authorization decree of 21 août 2006)*
- **Assess** the impact of the activities of the Centre on its environment
- **Detect** all abnormal situations or developments

Monitoring programme

Radiological monitoring

- Nearly 12 000 analyses of surface water (rivers, streams, etc.), groundwater, air, sediments, food chain, vegetation, milk and gaseous / liquid effluents

Non-radiological monitoring

- Chemical and physical-chemical analyses of water, noise and vibration, etc.

Monitoring the ecology of the surrounding environment (hydrobiology, fish inventory)

Statutory plan approved by the French nuclear safety authority

The environmental monitoring is based on environmental analysis carried out following the characterisation of the site :

- ✓ Waterways and outflows from the various water tables and rainwater seepage
- ✓ Main wind directions
- ✓ Description of environment compartments
- ✓ Location of agricultural activities and population groups
- ✓ Location of liquid and gaseous effluent releases
- ✓ Location of radioactive waste disposal vaults
- ✓ Nature of waste

Radionuclides and chemical elements of concern

Choice dictated by:

- **Inventory of the elements present in the waste**

✓ 125 radionuclides declared - RN chosen according to two criteria :

- The most abundant radionuclides in the inventory: ^{60}Co, ^{137}Cs, ^{134}Cs, ^{3}H, ^{55}Fe, ^{63}Ni, ^{14}C, ^{90}Sr, etc.
- The radionuclides with the greatest potential impact during the operational and post-monitoring phases (water / air transfer): ^{99}Tc, ^{93}Mo, ^{129}I, ^{36}Cl, ^{3}H, ^{239}Pu, ^{240}Pu, etc.

✓ 14 toxic chemicals declared in the waste and present in the construction concrete : Cr, Pb, Ni, Cd, As, Hg, B, etc.

- **The natural presence of elements in the environment** (^{238}U, ^{234}U, ^{210}Pb, natural water systems)

Radiological measurements

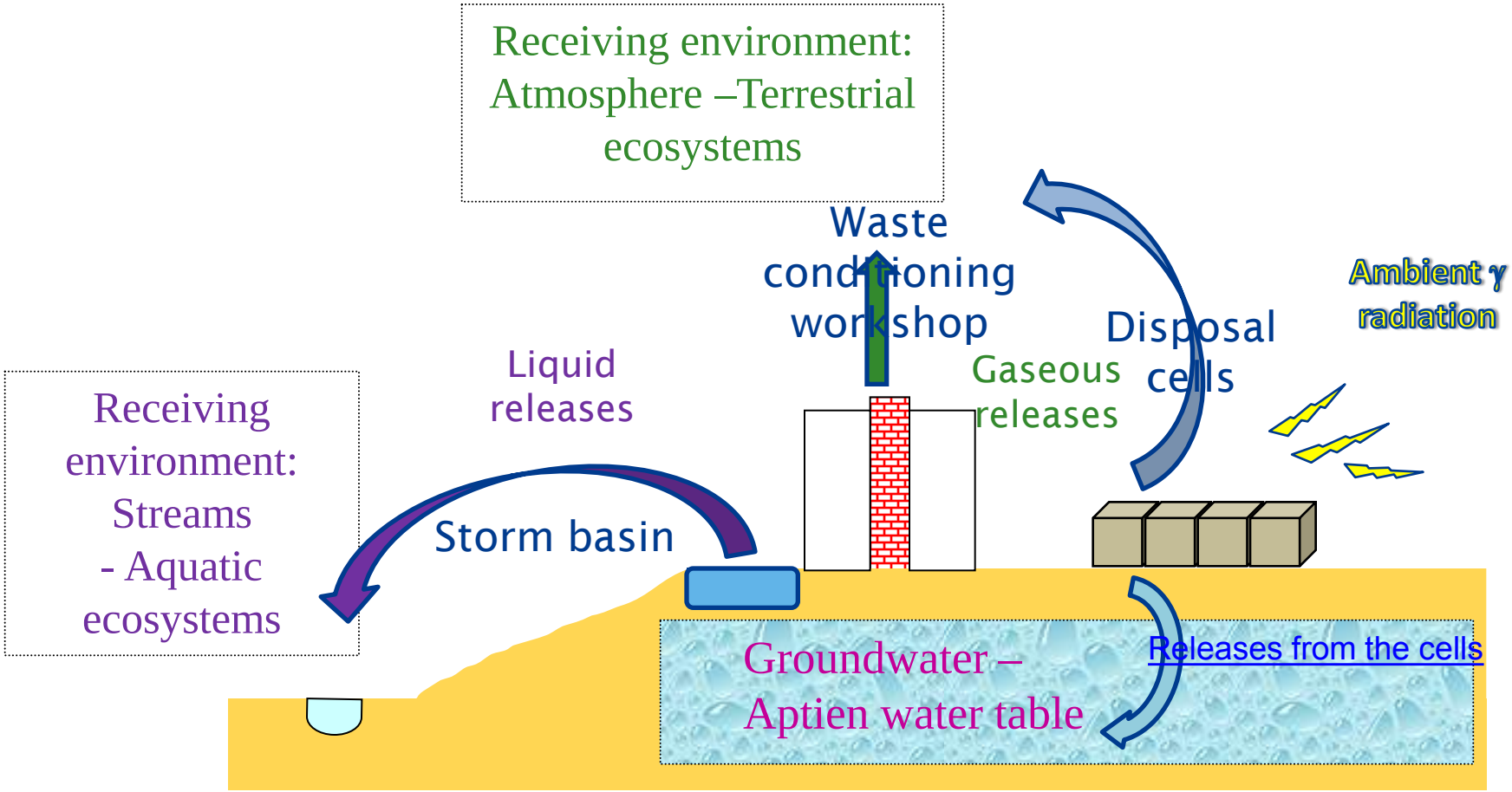
✓ Global measurements – High frequency

- Counting (α global, β global)

✓ Selective measurements – Discrimination of radionuclides

- Alpha Spectrometry: ^{239}Pu, ^{240}Pu, ^{238}U, etc.
- Gamma Spectrometry: ^{137}Cs, ^{60}Co, ^{134}Cs, iodine, etc
- Scintillation liquid: ^{3}H, ^{14}C, ^{36}Cl, ^{55}Fe, ^{99}Tc, ^{63}Ni, etc.
- X-ray Spectrometry: ^{59}Ni, ^{93}Mo

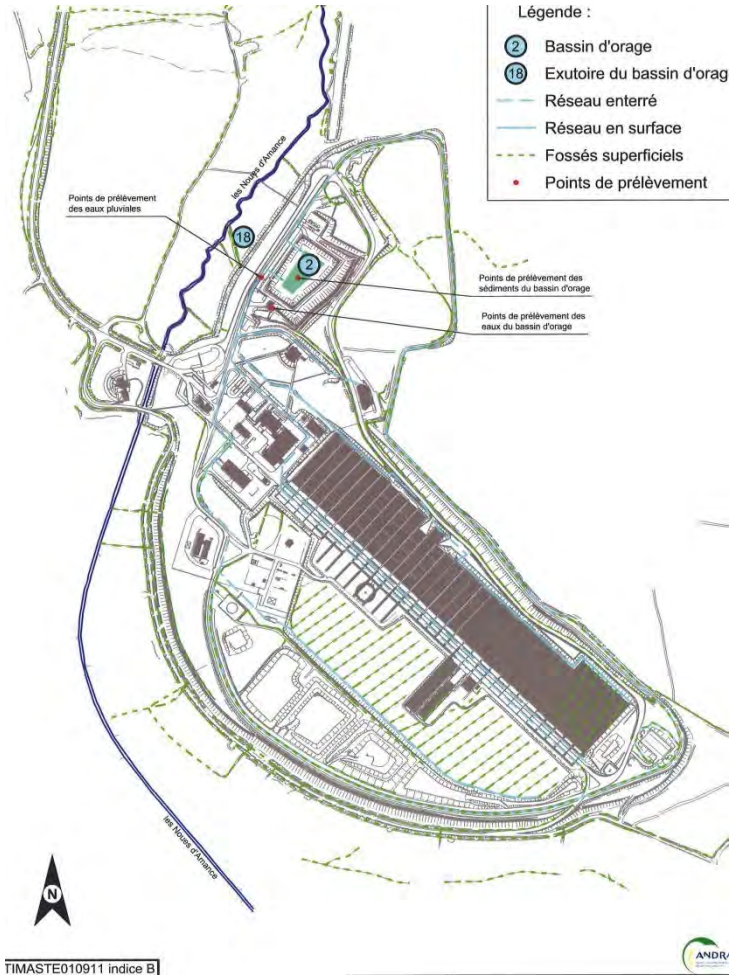
Potential pathways



Types of liquid effluent

- Runoff water (rainfall collected by rain water collecting system – nearly 90% of liquid releases)

Rainwater collecting system



All the rainfall in the nuclear area

- is collected…
- by a specific collecting system*…
- to the storm basin…
- and controlled…
- before drained away to the natural environment (river).

**[rainwater system is different from the separative system]*

Types of liquid effluent

- Runoff water (rain collection system – nearly 90% of liquid releases)
- Sewage and inert water (treatment plant)

Sewage system and treatment plant

Types of liquid effluent

- Runoff water
- Sewage and inert water (treatment plant)
- Water produced in the various facilities: Type A Effluent

Type A effluent system and collection tanks

Container injection process – Rinsing the injection plant

Work of the radiological analysis laboratory

Tanks

Sampling for radiological characterisation

Compared to regulatory requirements

Types of liquid effluent

- Runoff water
- Sewage and inert water (treatment plant)
- Water produced in the various facilities: Type A effluent
- Water collected via the Underground Separative Gravity-Driven Network under certain conditions

Collection of water from under the vaults

The Underground Separative Gravity-Driven Network

Protection against rainwater

Construction above the water table

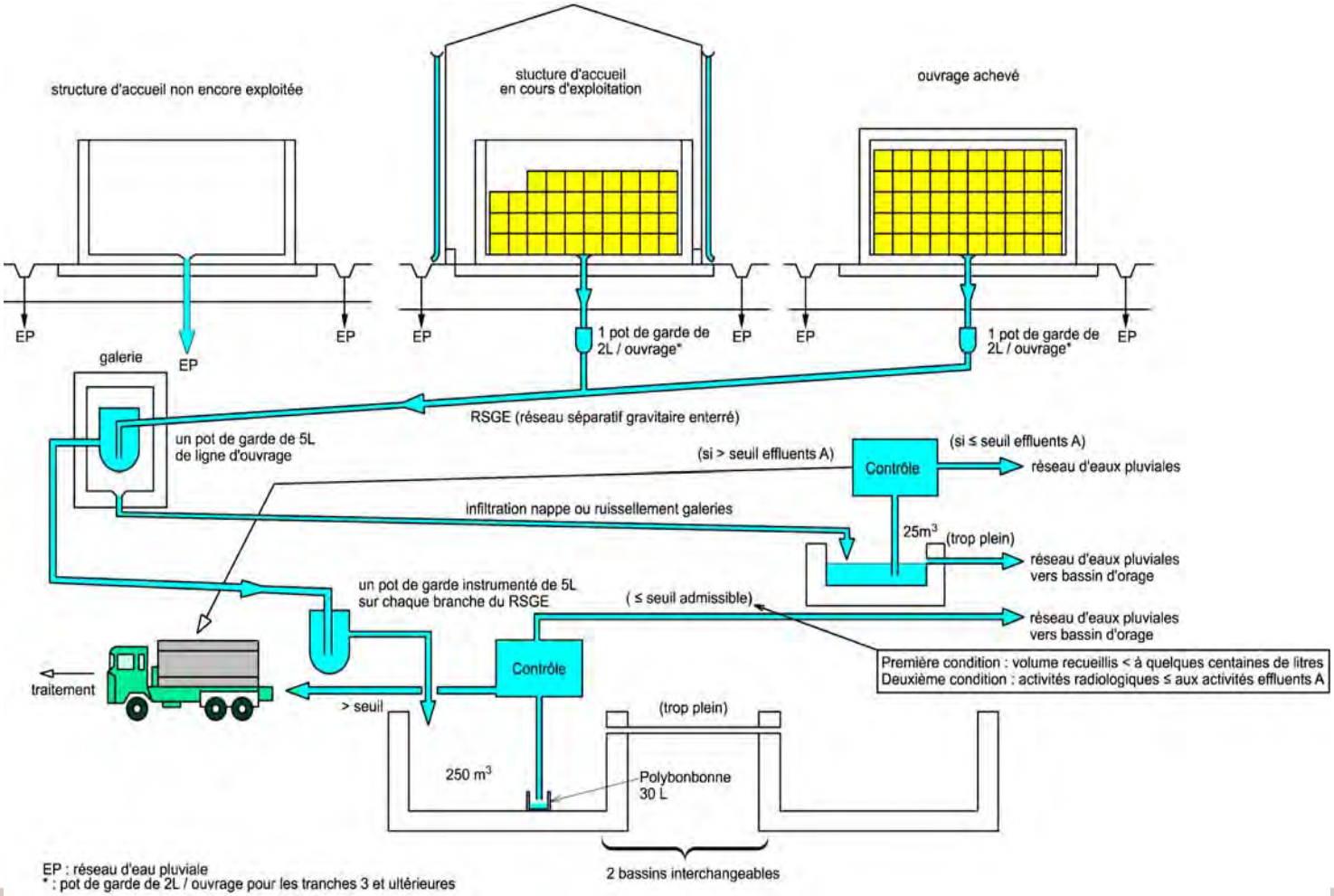
An underground separative water collection system

Collection of water from under the vaults

Underground Separative Gravity-Driven Network

Collection of water from under the vault

Underground Separative Gravity-Driven Network



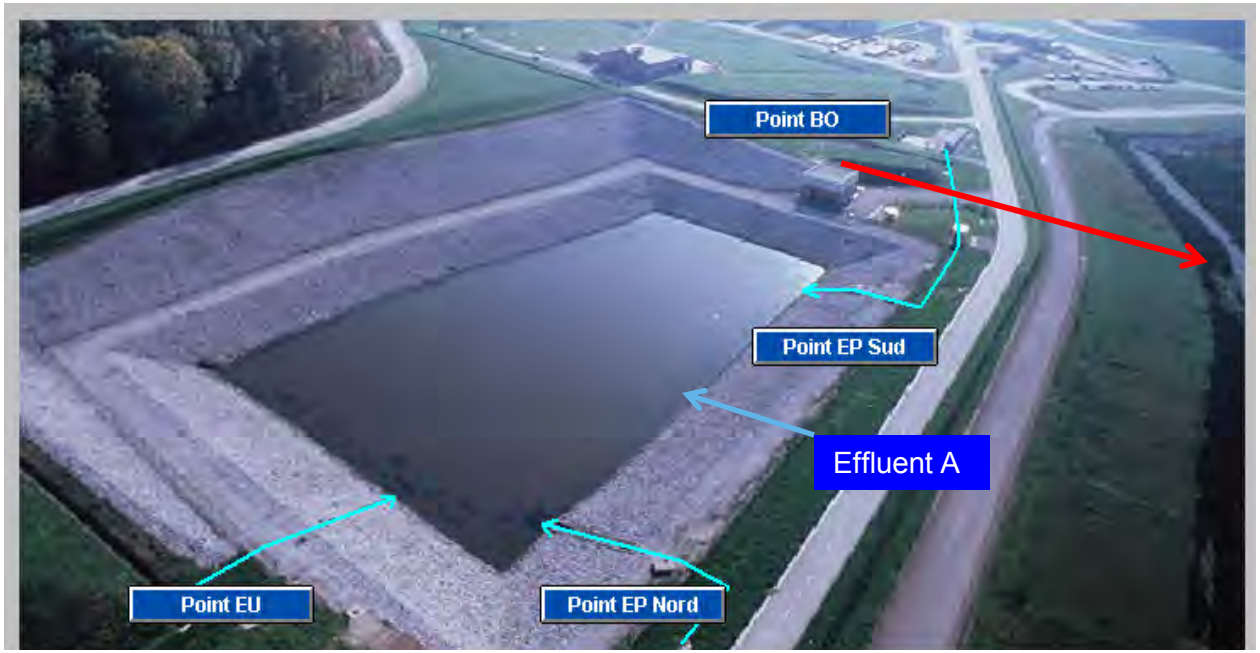
Types of liquid effluent

- Runoff water
- Sewage and inert water (treatment plant)
- Water produced in the various facilities: Type A effluent
- Water collected via the Underground Separative Gravity Network under certain conditions

⇨ Collection point for all this water prior to release into the Noues d'Amance stream :

The Storm basin

The Storm basin



The storm basin is a water reserve for firefighting (10 000 m^3)

The storm basin is a big tank to regulate the flow of rainwater during storm

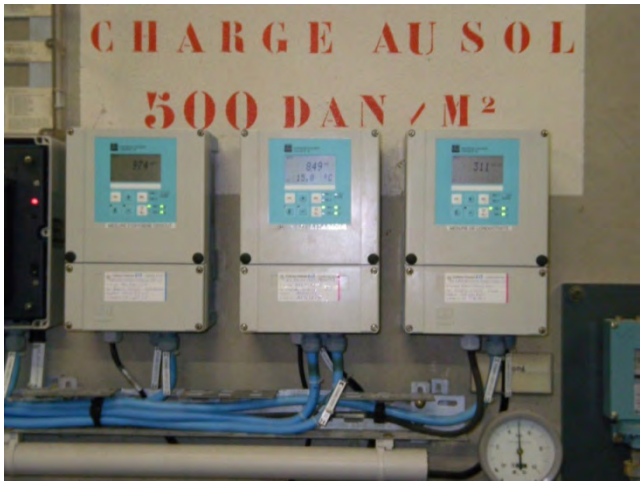
-Size of the storm basin : 30 000 m^3

-For the ten yearly rain : 46.9mm/24h

Water in the storm basin - Outlet

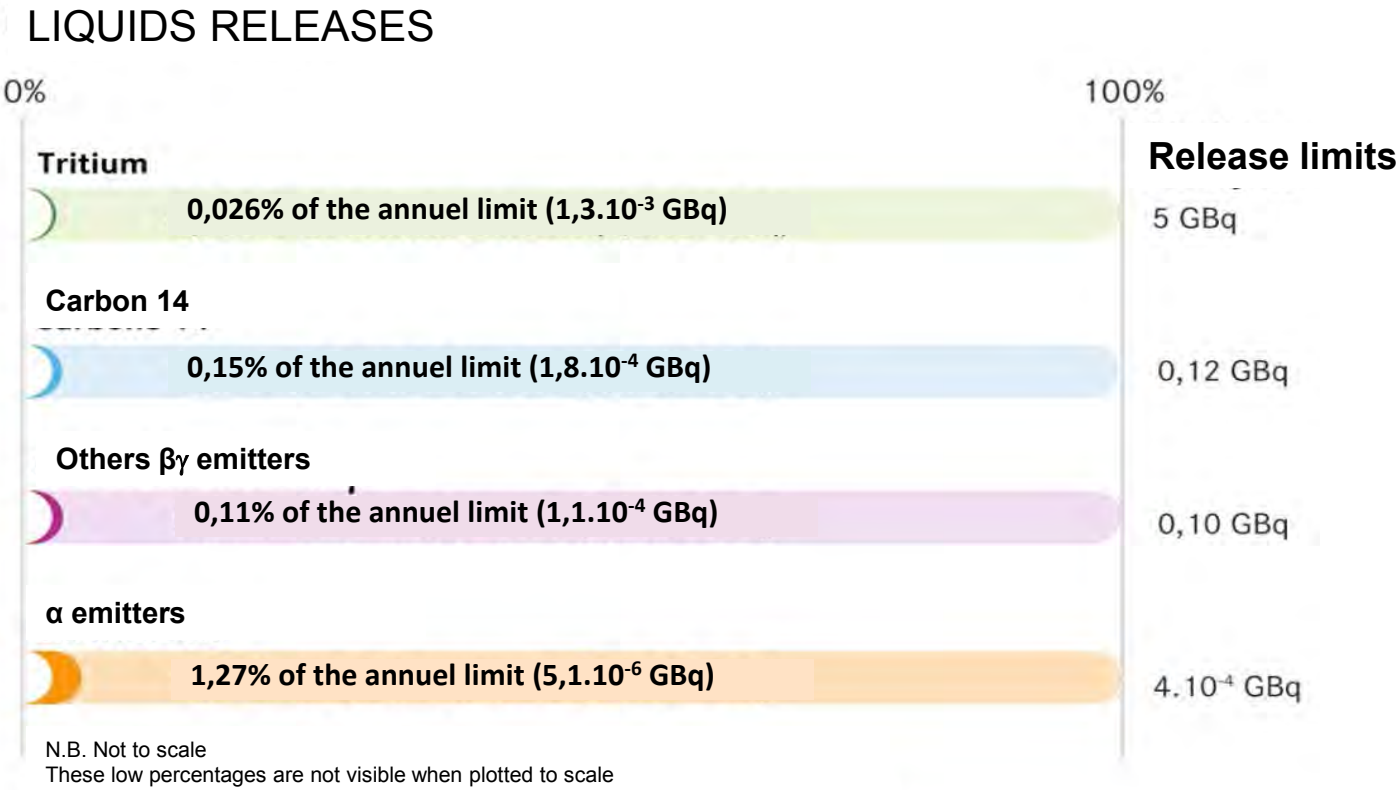
Radiological quality control
Automatic sampler

Measurement of release volume and flow rate
Flow meters



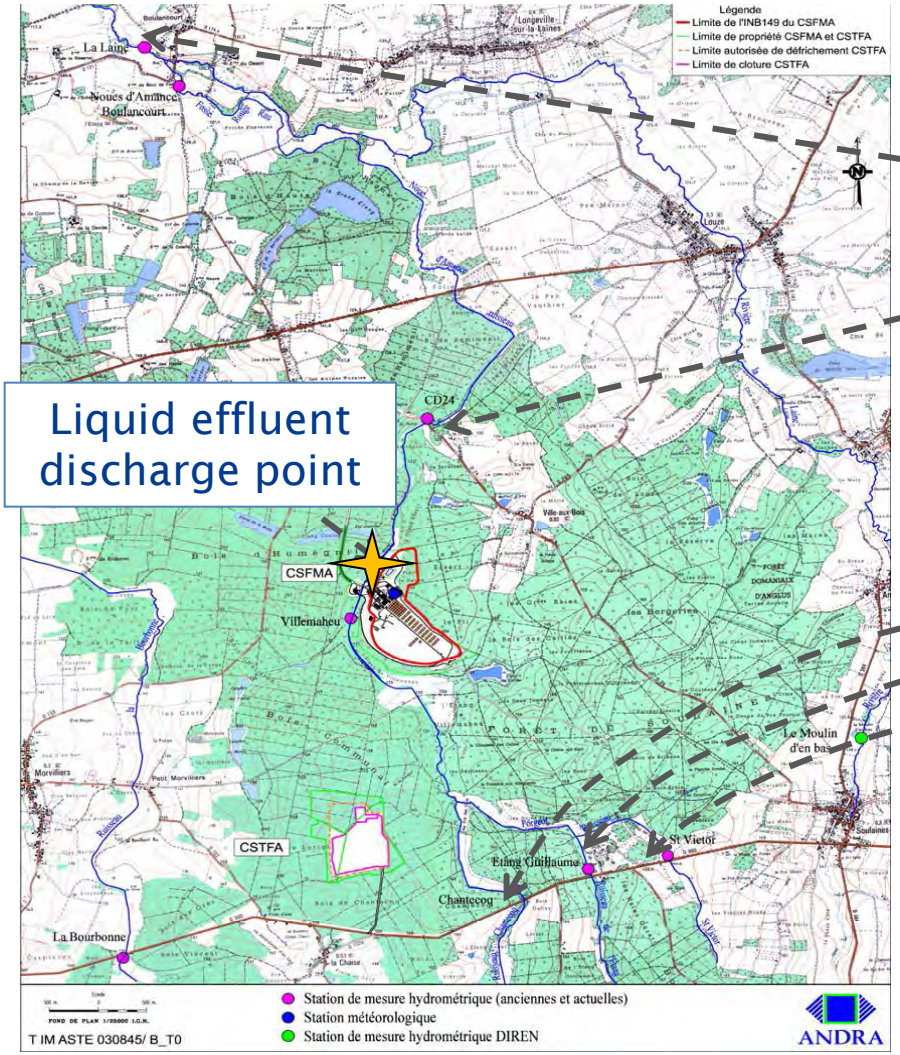
Physical-chemical quality control
Discrete sampling and continuous measurement
(pH, T°, conductivity, dissolved oxygen)

Radiological liquid releases in 2014



- Compliance with the annual release limits defined in the Releases Decree

Streams – Water monitoring



Liquid effluent discharge point

UPSTREAM / DOWNSTREAM monitoring scheme

» Far downstream – La Voire – Point R4

» Near downstream – Noues d'Amance – Point R2

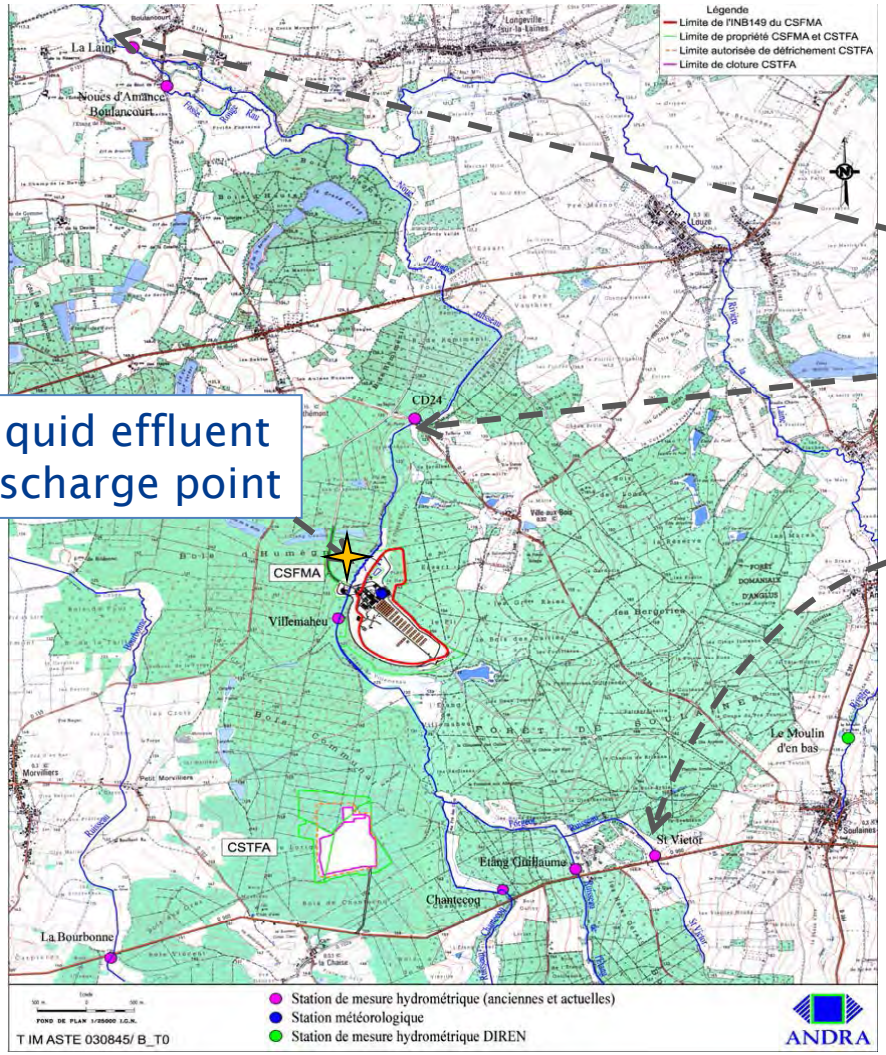
» Upstream to the Noues d'Amance – Point R1 - Mean sample derived from:

- Chantecoq (point R1a)
- Etang Guillaume (point R1b)
- Saint-Victor (point R1c)

Continuous liquid discharge into the stream

↳ **Appropriate discrete sampling**

Streams – Sediment monitoring



Liquid effluent discharge point

UPSTREAM / DOWNSTREAM monitoring scheme

» Far downstream – La Voire – Point SR4

» Near downstream – Noues d'Amance –

Point SR2

» Upstream to the Noues d'Amance – Saint-Victor stream –

Point SR1a

Monitoring the aquatic ecosystem

- Aquatic vegetation monitoring

Contributes to the bio-accumulation of radionuclides and toxic chemicals – Active bio-surveillance (radiological monitoring) or passive bio-surveillance (physical-chemical monitoring).

Burbot (Lota lota)

- Fish monitoring (electric fishing)

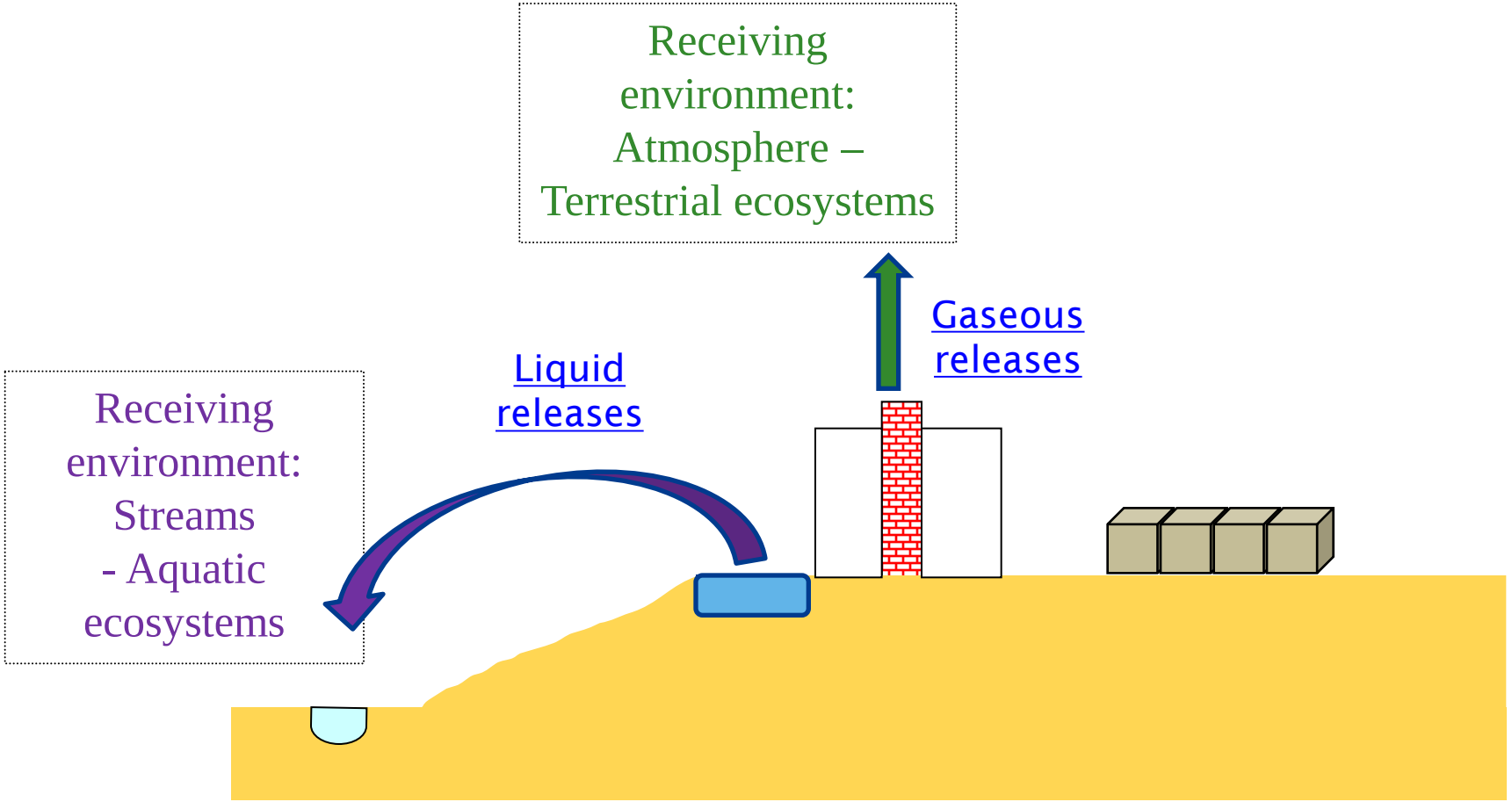
Used to establish an inventory and radiological characterisation of the fish population.

- Hydro-biological monitoring (IBGN index)

Used to assess the hydro-biological quality of an aquatic site by analysing the composition of benthic invertebrate populations living in the watercourse.

Oligochaete

Potential pathways



Gaseous releases from the package conditioning workshop stack

Two types of monitoring :

- ✓ 'Operational' monitoring : Reactivity

Based on continuous measurement with alarms transfer (tritium and αG and βG particle/aerosol measurements)

- ✓ 'Fine' monitoring: Accurate quantification of releases

Based on continuous sampling with later measurements :

- Dust and aerosols
- Tritium
- Iodine (^{129}I, ^{131}I, ^{125}I)
- Carbon 14

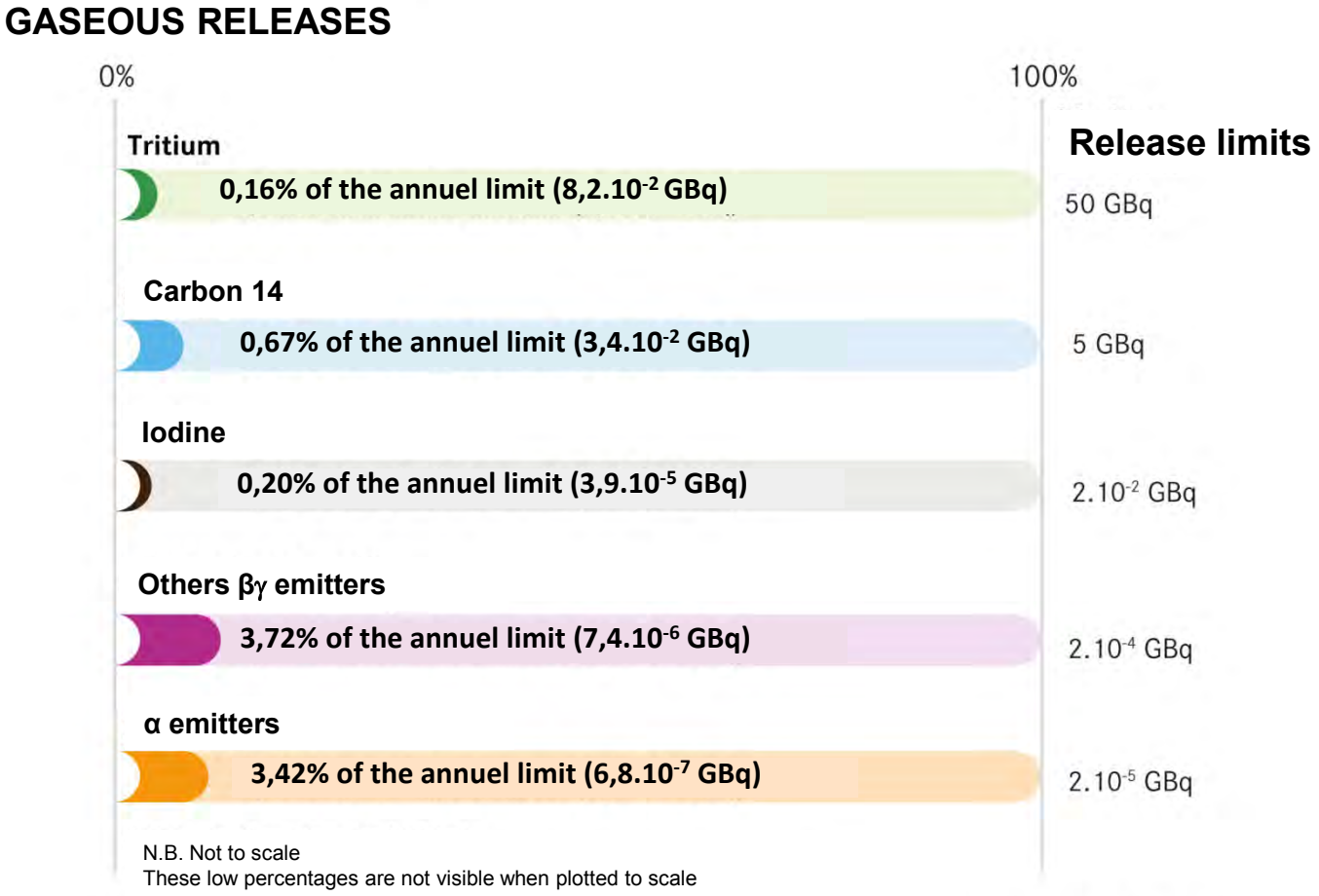
Atmospheric sampling equipment

Dust/aerosols and iodine sampling equipment

Tritium and carbon 14 sampling equipment

Radiological gaseous releases in 2014

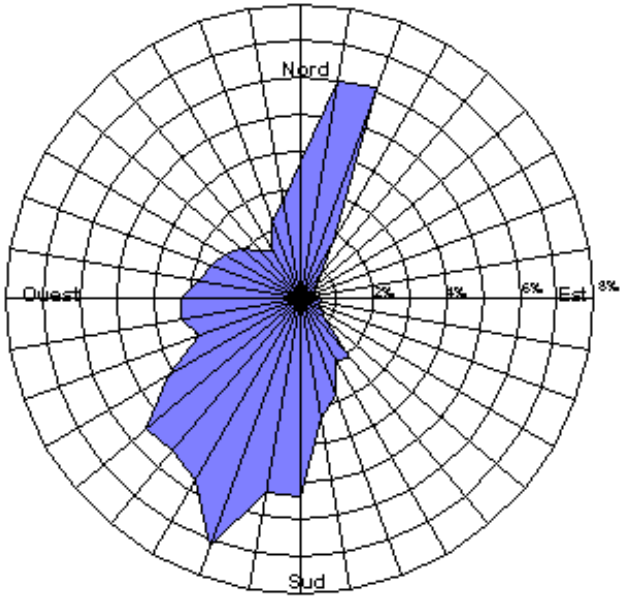
(waste conditioning workshop)

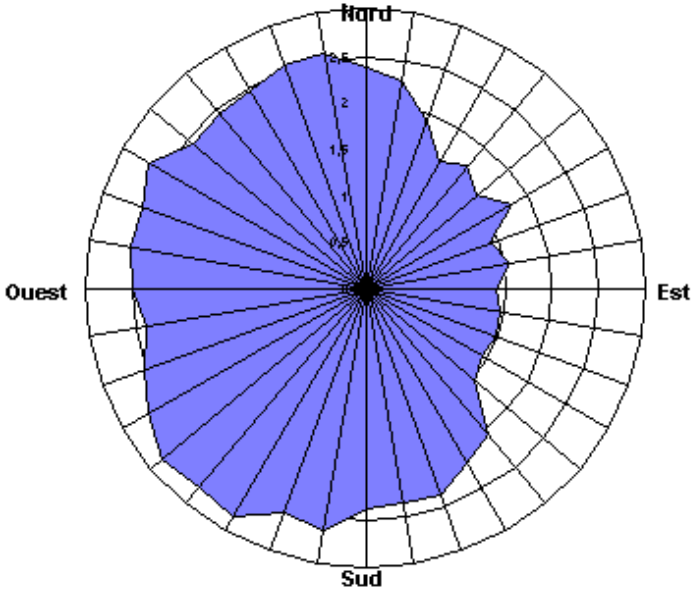


- Compliance with the annual release limits defined in the Releases Decree

Location of sampling areas

Wind roses

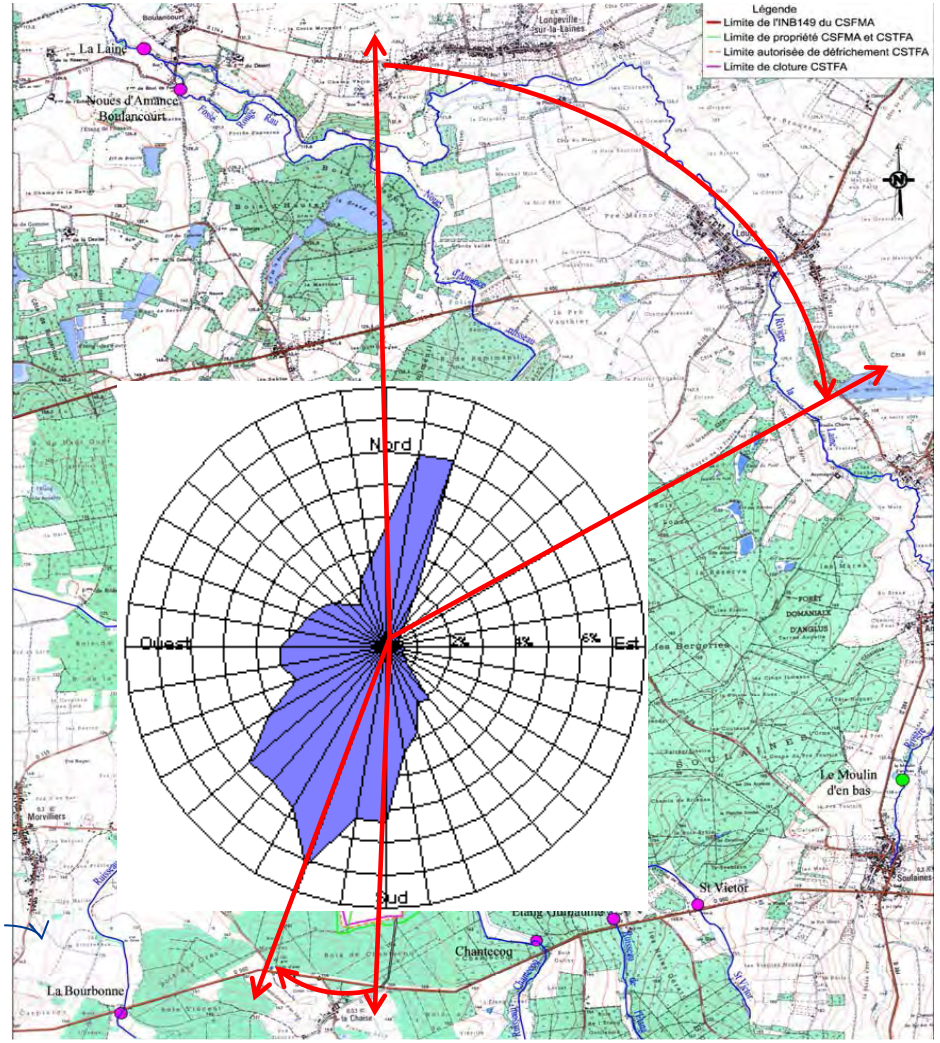




Mean wind direction and frequency
2 prevailing wind directions
- South-South/West
- North-North/East

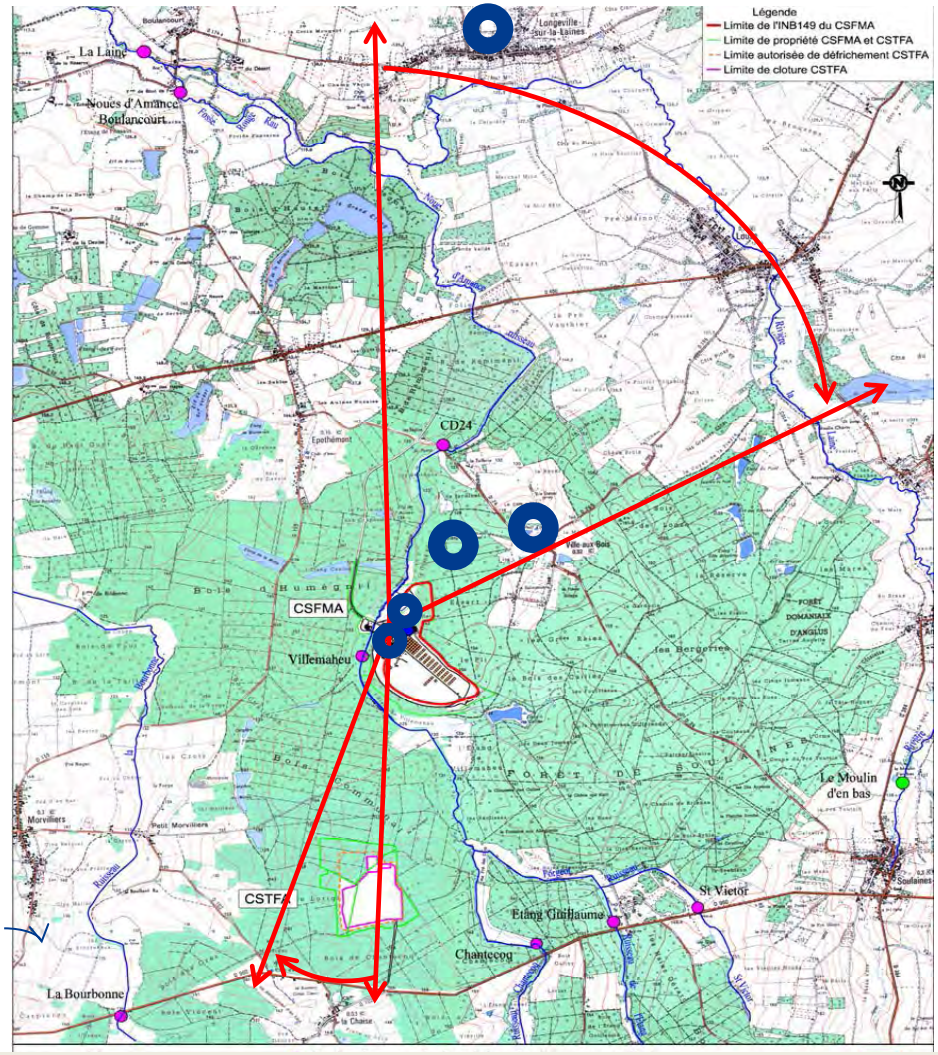
Mean wind force (m/s)
Weak winds (<2,5 m/s)

Location of sampling areas



Location of sampling areas

- ✓ Off site
- ✓On site (two sampling stations)



Types of on site monitoring

- Ambient air monitoring – Radiological measurements

Based on continuous sampling with later measurement:

- Dust and aerosols
- Tritium
- Iodine (^{129}I, ^{131}I, ^{125}I)
- Carbon 14

Tritium and carbon 14 sampling equipment

Iodine cartridge

Filter

Atmospheric sampling areas

Types of on site monitoring

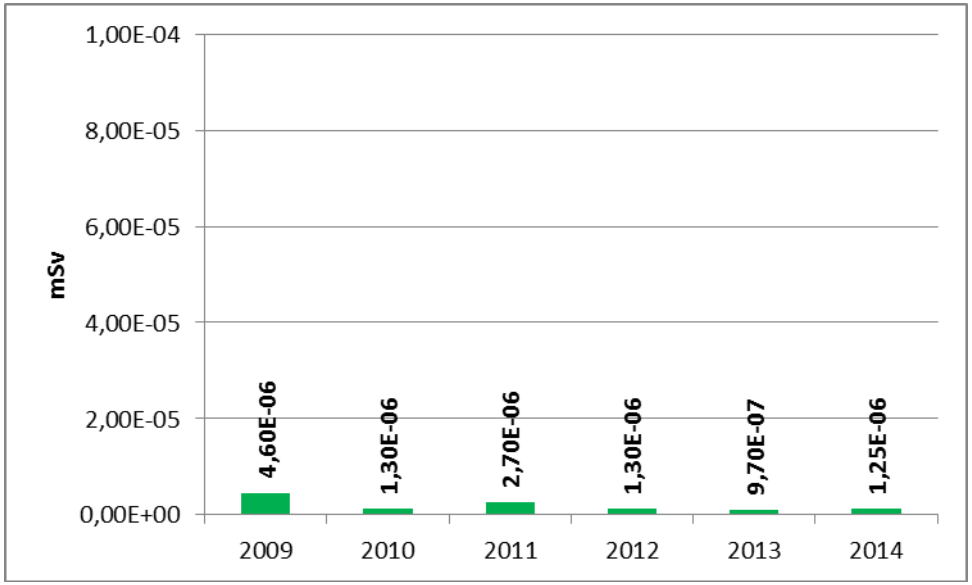
- Other monitoring for radiological measurements
  - ✓ Rainwater
  - ✓ Terrestrial vegetation
  - ✓ Soil

Types of off site monitoring

- Terrestrial vegetation
- Food chain
  - ✓ Milk
  - ✓ Cereals
  - ✓ Mushrooms
  - ✓ Fish

Radiological impact on the reference group* in 2014

0.00125 microsieverts / year, i.e. less than one 800 000th of the permitted dose for the general public (1 millisievert / year)



*Reference group: The adult population living close to the Noues d'Amance along the D24 road – Assumed to be fully independent. The contribution from drinking water is $1{,}2.10^{-9}$ mSv/year.

Central control of monitoring installations

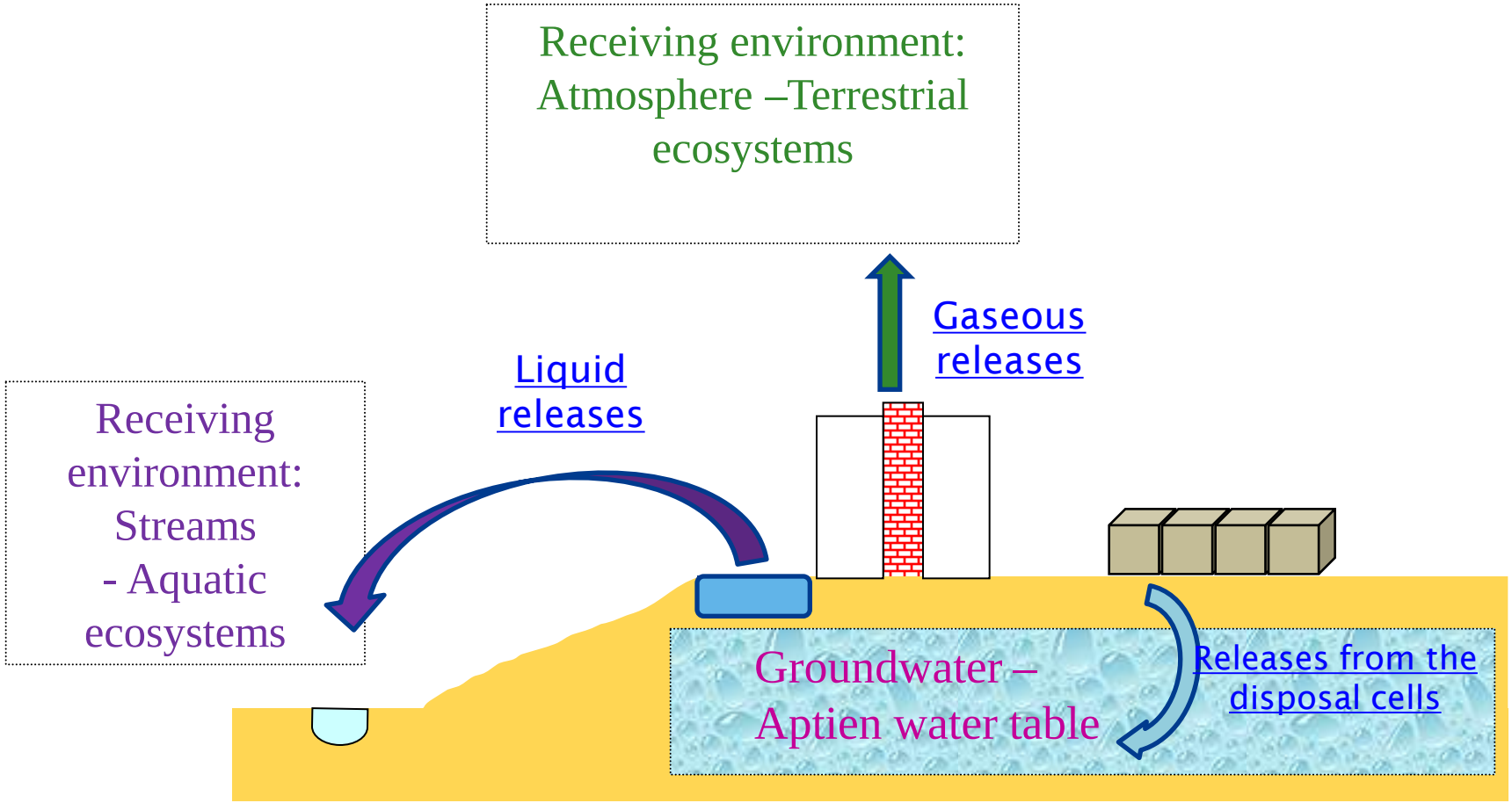
All the measurements and data from the various monitoring installations (liquid and gaseous releases and atmospheric monitoring) are **brought together** in

The Monitoring Information System

This is used to:

- ✓ Display monitoring data in real time.
- ✓ Configure the instruments.
- ✓ Process and archive all the data.

Potential pathways



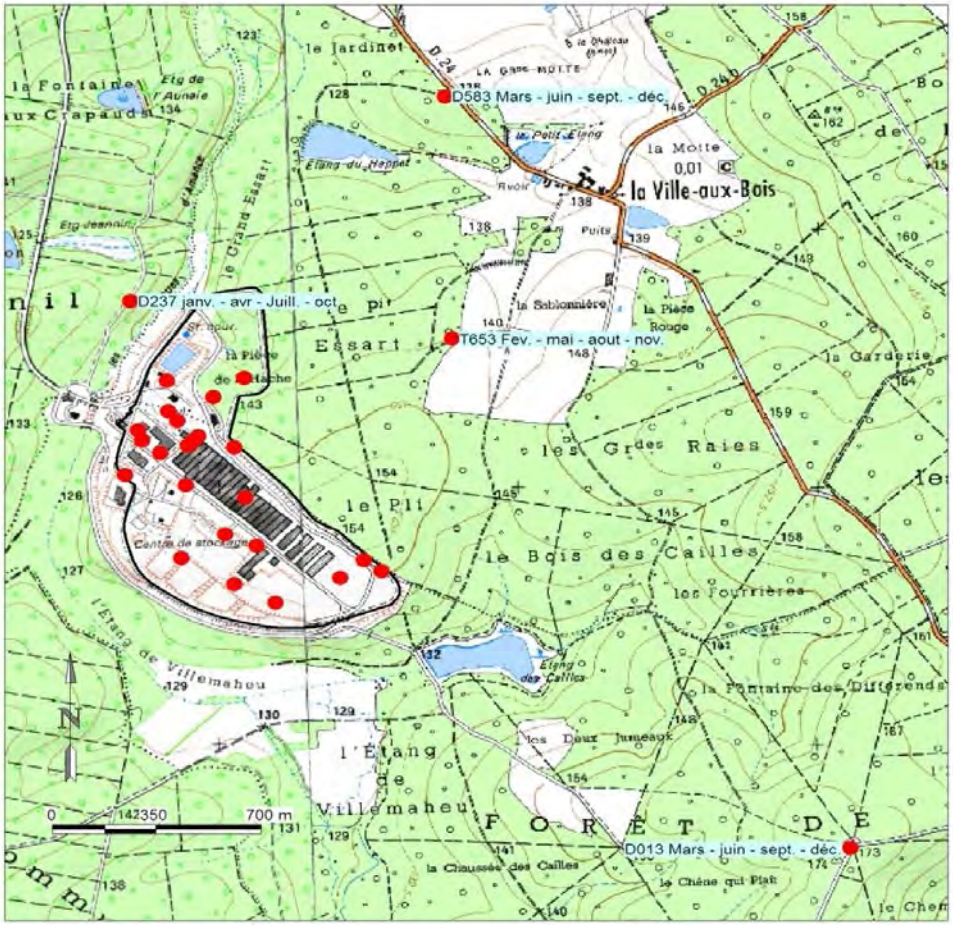
Monitoring the Underground Separative Gravity-Driven Network

First indicator of any potential transfer of contamination to the water table (water transfer)

- ✓ Seal pot for each cell or row of cells
- ✓ Weekly check of runoff flow rates
- ✓ Radiological characterisation of runoff water

24 L of effluents collected in 2014

Monitoring the Aptien water table



Location of ground water sampling points on site and outside the ANDRA CSFMA site

Sampling water from the Aptien water table – Radiological and physical-chemical characterization of the Aptien aquifer

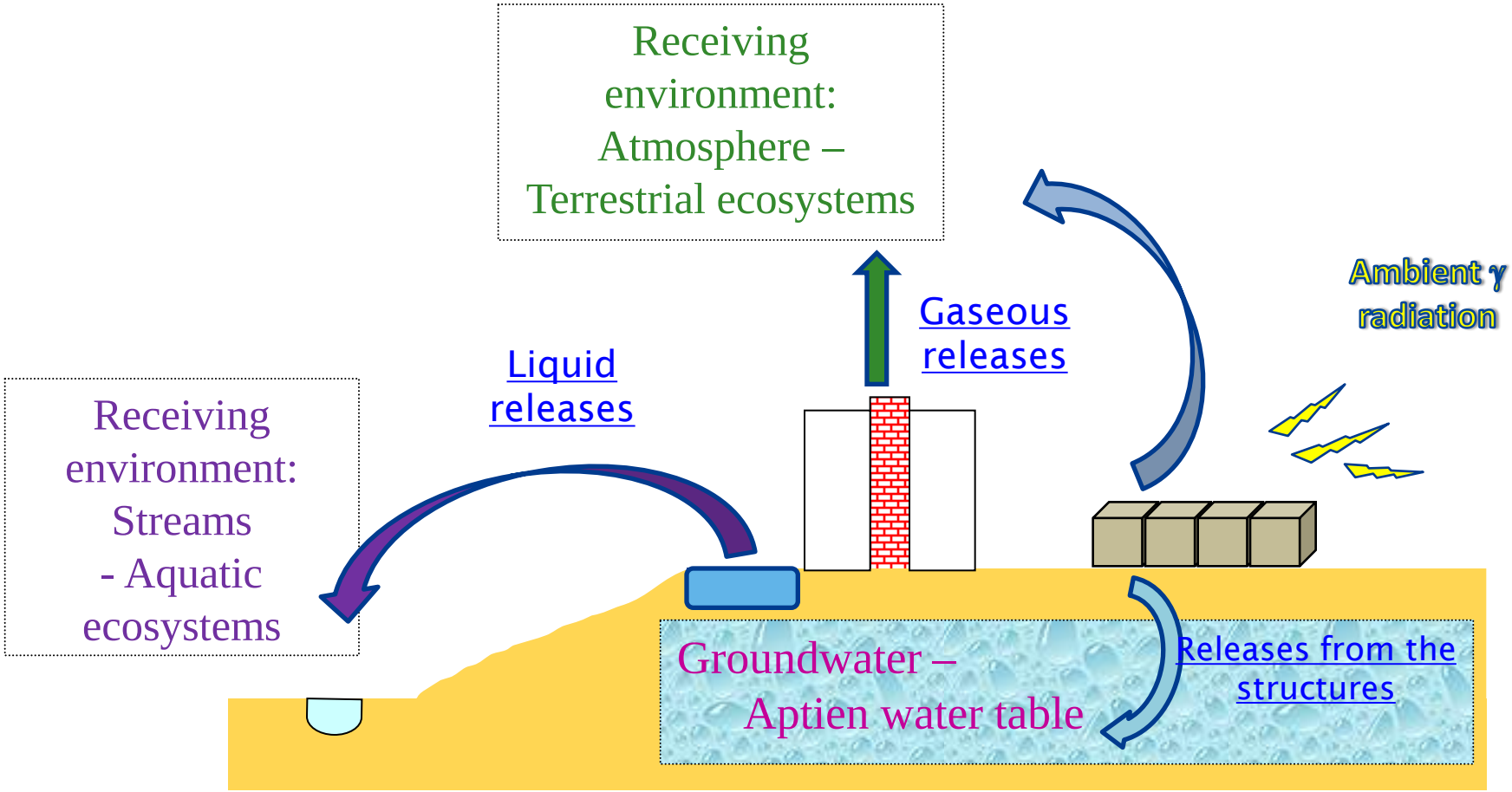
- 28 piezometers subject to routine sampling

Monitoring the Aptien water table

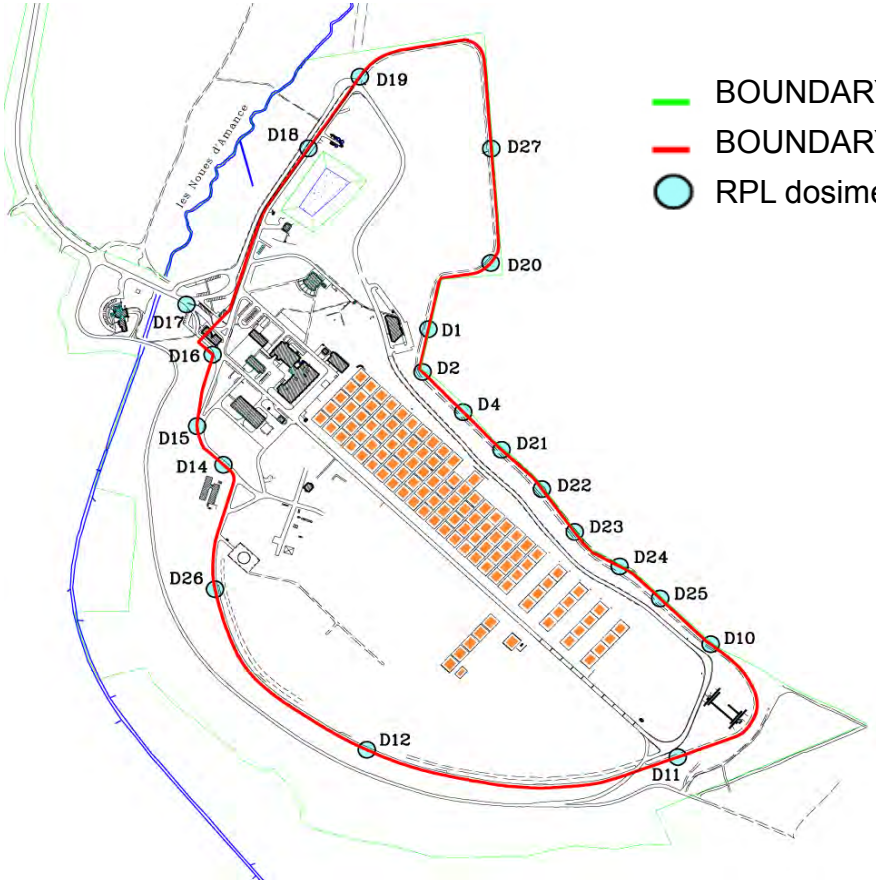
Sampling water from the Aptien water table – Radiological and physical-chemical characteristics

- ✓ Borehole sampling in the central disposal area (monthly)
- ✓ Downstream borehole sampling of water table from the structures (quarterly)
- ✓ Upstream borehole sampling of water table water from the structures (monthly)
- ✓ Borehole sampling outside the area affected by the activities of the Centre (quarterly)

Monitoring ambient γ radiation



Boundary dosimetry



BOUNDARY OF ANDRA PROPERTY
BOUNDARY OF BNI 149
RPL dosimeters

- 20 low-threshold dosimeters distributed along the Centre boundary
- 1 reference dosimeter away from the influence of the Centre (La Chaise)

Boundary dosimetry

Comparison with the reference dosimeter located at La Chaise

Analytical data is compared with:

- Data from the preliminary radio-ecological site survey carried out between 1986 and 1991

  Several sampling campaigns during the selection and construction of the site:

  - Radio-ecological study between June 1986 and June 1987
  - Updating of the setting zero point between July 1990 and March 1991

- Recorded data from the start of operation in January 1992

- Intermediate radio-ecological monitoring :

  - Survey of $^{3}H/^{14}C$ in the environment
  - Sampling and analysis campaigns focussed on specific matrices (felled trees, salads, lichens, mosses, etc.) in partnership with local community organisations (Local Information Committee)

Traceability of monitoring date

In 2006, ANDRA set up an environmental database known as DESIREE.

The data stored in this database includes:

- ✓ Radiological data
- ✓ Physical-chemical data

This database provides traceability for the data obtained from environmental monitoring and liquid effluent monitoring from the initial sampling to the distribution of the results.

Traceability of monitoring date

The database is also a tool to help :

✓ Data integration

At each step (sampling with the request analysis and laboratory results entry), automated tests can be implemented to minimize errors of data integration (sampling date, measurement date, forgotten values, values outside thresholds)

✓ Data validation

The database provides graphs, average calculation, highlighting significant values that can help identify outliers and changing levels evolution

✓ Preparation of reports

The database automatically creates tables of results to be included in the various reports

Distribution of monitoring results

- **The French nuclear safety authority**
  - Monthly records
  - Annual report with interpretation

- **Public**
  - ANDRA website: www.andra.fr
  - Annual report (in accordance with Article 21 of the TSN Law)
  - Annual meeting with the Local Information Committee
  - Open days and group visits
  - National environmental measurements network

réseau national
Réseau national de mesures de la radioactivité de l'environnement

Thanks for your attention